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A STUDY OF WEIGHT GAIN IN THE FIRST YEAR OF LIFE

BY

JESSIE PARFIT

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INTRODUCTION

The present investigation relating to 662 boys and 620 girls born in Oxford between 1944 and 1948 was designed to observe the relation of sex and birth weight to growth during the first year of postnatal life. A majority of the babies (702) came from one private and two municipal welfare clinics in the city; the remainder (580) attended the Institute of Social Medicine. The latter are also enrolled in the Child Health Survey and are the subjects of a more intensive study of growth and development during the first five years of life (Thwaites, 1950).

The babies attending the Institute of Social Medicine were seen for the first time at 4 weeks, and again at 3, 6, 9, and 12 months. The remainder were brought to the clinics at monthly intervals. Since the two municipal clinics were held in the same room but on different days, only three different weighing scales (balance type) were used. Four persons were responsible for the records, but each baby was supervised by the same person; they were weighed naked on the same scales, and the weight was recorded to the nearest whole ounce. Although the mothers often failed to bring their children on the appointed dates, in most cases the first visit, due at one month, did not vary by more than a week from the correct day, and those due at 3, 6, 9, and 12 months were rarely more than two weeks too early or too late. In the exceptional cases an estimated weight for the correct date has been obtained from a curve drawn through the five recorded weights. In the result, the weights used in this paper have been derived from actual weighing and from graphic estimation in the following proportions:

Babies	Weighings	Estimations
651	5	—
443	4	1
129	3	2
59	2	3

No baby was included for whom there were less than five recorded weights, and graphic interpolation was therefore used only to correct for date, and never to fill up an incomplete record.

Birth weights were obtained from the mothers on their first visits. In several cases it was possible to check this statement and no major discrepancies between the stated and the actual weight were detected. In view of this, and also of the work done by Asher and Fraser Roberts (1949), the stated birth weight was accepted in every case.

The social-class distribution of the fathers of babies attending the Institute of Social Medicine compared with that of all males in 1931 (Registrar-General, 1931) includes an excess in Class III and a corresponding deficit in Classes IV and V.

Social Class	Percentage	
	Institute Series	England and Wales
I	5	3
II	10	14
III	67	48
IV	10	18
V	8	17

It is likely, therefore, that it represents a better than average series. It should be noted, however, that owing to the extreme housing shortage in Oxford, less than half the families had a home of their own (Thwaites, 1950). No record of the father's occupation was kept by the Welfare Clinics, but since this part of the sample includes 206 babies from a private clinic and 496 from municipal clinics in a good residential area, it is probable that it also includes a relatively large number of babies in the higher social classes.

There was no record of birth rank in 11 per cent. of the cases attending Welfare Clinics. Apart from minor differences in the higher birth ranks, the remainder corresponded closely to the Institute cases of which 45·9 per cent. were first, and 31·3 per cent. second babies.

Records	Institute Series	Clinic Series
No records	5 (adopted)	74 (11%)
With records	575	628
Birth Rank	%	%
1	45·9	45·9
2	31·3	29·3
3	11·6	15·8
4 and over	11·1	9·1

In 42·5 per cent. of the records obtained from the Welfare Clinics there was no mention of the mother's age. Judging by the remainder the most noticeable difference between the two series is in respect of the mothers aged 40 and over. This difference may be due to a tendency on the part of Welfare Clinics to record

unusual events (e.g. an exceptionally old mother) more often than "normal findings".

Records	Institute Series	Clinic Series
No records	5 (adopted)	298 (42·5%)
With records	575	404
Mother's Age	**%**	**%**
20 years	3·0	3·2
20–24	19·8	20·8
25–29	31·3	26·2
30–34	25·0	26·9
35–39	17·0	16·5
40 and over	3·8	6·2

Weight Records

In order to observe the effect of sex and birth weight on subsequent growth, six birth-weight groups and five age periods were defined and the records for each sex analysed separately. For convenience, the birth-weight groups (which range from 5½ lb. and under to 9½ lb. and over) have been numbered 5 to 10 (see Table II, p. 4).

When the serial weight records were arranged according to age and sex and the findings for the children attending the Institute and the Clinics were compared, only minor differences were detected. Since none of these was statistically significant the two series have been combined for all subsequent analyses.

TABLE I

Weights in the First Year of Life

(A) comparison of 662 boys with 620 girls (combined series)

Age (months)	Weights			
	Boys (662)		Girls (620)	
	Average	S.D.	Average	S.D.
	lb. oz.	lb. oz.	lb. oz.	lb. oz.
At birth	7 10	1 1	7 6	1 1
1	9 0	1 0	8 8	1 0
3	13 1	1 8	12 1	1 5
6	17 8	1 12	16 4	1 10
9	20 12	2 1	19 2	1 15
12	23 2	2 5	21 8	2 2

(A) Analysis by Sex

A direct comparison of the average weights at successive age periods revealed a significant difference* between the boys and girls which became progressively greater with increasing age (see Table I). Thus at birth the average weight of the

* Throughout this paper, the difference between two mean values is said to be significant if it is more than *three* times the standard error of the difference.

boys exceeded that of the girls by 4 oz.; by six months there was a difference of 20 oz., and at the end of the year the difference was 26 oz. This finding shows that the boys had grown faster than the girls prenatally (and so were heavier at birth) and that this difference in weight gain continued to increase for at least twelve months.

TABLE II

WEIGHTS* IN THE FIRST YEAR OF LIFE
(B) COMPARISON OF BOYS AND GIRLS IN SIX BIRTH-WEIGHT GROUPS

Sex	Group No.	Range of Birth Weight	Total Nos.	Average Weights*																	
				At Birth				At 1 month				At 3 months				At 6 months				At 9 months				At 12 months			
				Average		S.D.		Average		S.D.		Average		S.D.		Average		S.D.		Average		S.D.		Average		S.D.	
				lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.
Boys	5	5: 8 and under	25	4	14	0	8	6	15	0	13	10	2	1	5	14	5	1	10	17	11	1	11	19	15	2	5
	6	5: 9–6: 7	83	6	2	0	4	7	9	0	14	11	12	1	8	16	4	1	14	19	9	2	2	21	15	2	4
	7	6: 8–7: 7	193	7	2	0	4	8	10	0	15	12	12	1	4	17	3	1	11	20	2	1	13	22	5	2	2
	8	7: 8–8: 7	197	8	0	0	4	9	6	1	0	13	7	1	9	17	14	1	13	21	2	2	3	23	9	2	3
	9	8: 8–9: 7	126	8	14	0	4	9	12	0	15	13	15	1	8	18	9	1	9	21	12	2	3	24	7	2	9
	10	9: 8 and over	38	9	15	0	8	10	14	1	2	14	14	1	7	19	7	2	1	22	14	2	5	25	8	2	6
Girls	5	5: 8 and under	33	5	1	0	7	6	7	0	12	10	4	1	4	14	9	1	9	17	9	1	13	19	7	2	2
	6	5: 9–6: 7	96	6	2	0	4	7	6	0	11	11	0	1	3	15	7	1	10	18	3	2	0	20	4	2	2
	7	6: 8–7: 7	213	7	0	0	4	8	5	0	12	11	14	1	3	16	0	1	10	18	14	1	13	21	6	1	13
	8	7: 8–8: 7	195	7	15	0	5	8	15	1	2	12	10	1	7	16	11	1	11	19	10	2	1	22	0	2	6
	9	8: 8–9: 7	69	8	13	0	4	9	12	0	12	13	6	1	6	17	6	1	11	20	0	1	14	22	8	2	1
	10	9: 8	14	9	14	0	5	10	12	0	10	14	4	1	11	18	11	1	10	21	13	2	8	23	15	2	4

* The differences between the means of each group are all statistically significant, i.e. more than three times the standard error of the difference.

TABLE III

WEIGHT INCREMENTS IN THE FIRST YEAR OF LIFE
COMPARISON OF BOYS AND GIRLS IN SIX BIRTH-WEIGHT GROUPS

Sex	Group Number	Average Birth Weight		Total Numbers	Average Increments of Weight											
					Birth–1 month		1–3 months		3–6 months		6–9 months		9–12 months		0–12 months	
		lb.	oz.		lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.
Boys ..	5	4	14	25	2	1	3	3	4	3	3	6	2	4	15	1
	6	6	2	83	1	7	4	3	4	8	3	5	2	6	15	13
	7	7	2	193	1	8	4	2	4	7	2	15	2	3	15	3
	8	8	0	197	1	6	4	1	4	7	3	4	2	7	15	9
	9	8	14	126	0	14	4	3	4	10	3	3	2	11	15	9
	10	9	15	38	0	15	4	0	4	9	3	7	2	10	15	9
	All boys	7	10	662	1	6	4	1	4	7	3	4	2	6	15	8
Girls ..	5	5	1	33	1	6	3	13	4	5	3	0	1	14	14	6
	6	6	2	96	1	4	3	10	4	7	2	12	2	1	14	2
	7	7	0	213	1	5	3	9	4	2	2	14	2	8	14	6
	8	7	15	195	1	0	3	11	4	1	2	15	2	6	14	1
	9	8	13	69	0	15	3	10	4	0	2	10	2	8	13	11
	10	9	14	14	0	14	3	8	4	7	3	2	2	2	14	1
	All girls	7	6	620	1	2	3	9	4	3	2	14	2	6	14	2

(B) ANALYSIS BY BIRTH WEIGHT

When the records for the six birth-weight groups were examined the following facts emerged (see Table II).

(1) Except in the case of very small babies (Group 5), boys and girls in the same birth-weight groups had grown at different rates.

(2) The birth-weight groups for each sex retained their rank order throughout the period of study. This finding showed that the babies who were largest at birth had still retained their lead at the end of a year.

(3) The differences between the birth-weight groups remained approximately the same at each age. Fig. 1 shows that once the lines representing the serial mean weights of the boys in each birth-weight group are well established, they tend to run parallel. The corresponding record for the girls (unpublished) also shows parallel lines but here the lines are less steep owing to the slower rate of growth.

The implication of this finding is that the actual amount of weight gained in each age period was greater for the boys than for the girls, but after the first month it was approximately the same for large and small babies of the same sex (see Table III). In Table III the actual weight increments for each age period are shown for the two sexes and six birth-weight groups. If the boys in Groups 6 and 9 are compared it will be seen that they both gained the same amount of weight between one and three months; thereafter the successive increments varied by 2 oz., 2 oz. and 5 oz.

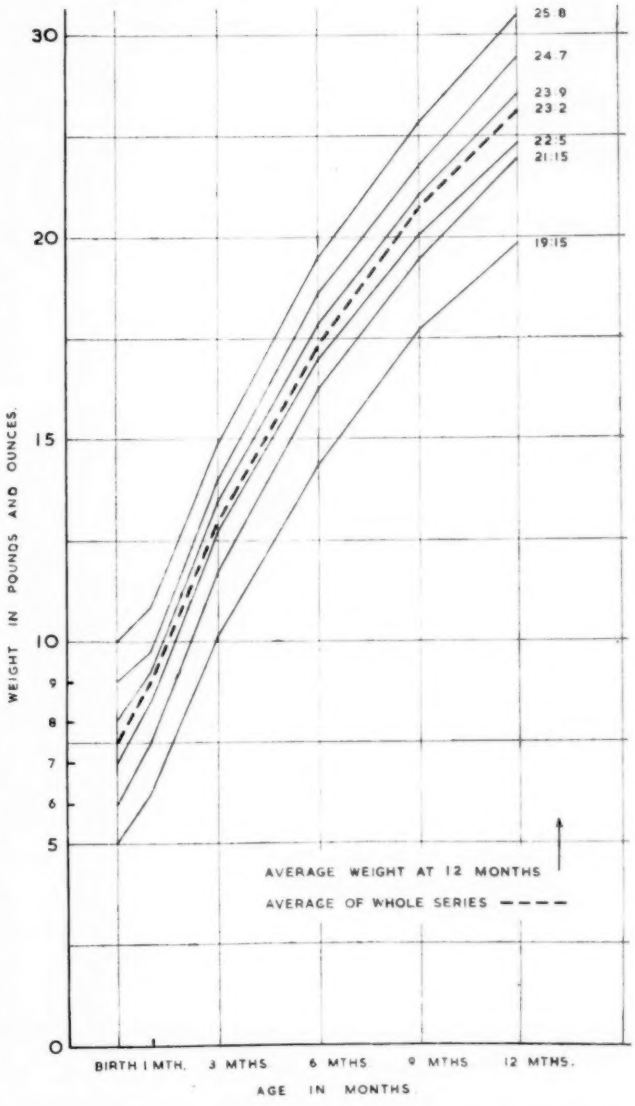

FIG. 1.—Average weight gain in the first year of life. Comparison of six birth-weight groups (boys only).

respectively. If the girls in Groups 7 and 8 are compared, even smaller differences will be seen. In other words, although sex had had an appreciable effect on the absolute amount of weight gained, the effect of birth weight appears to have been negligible.

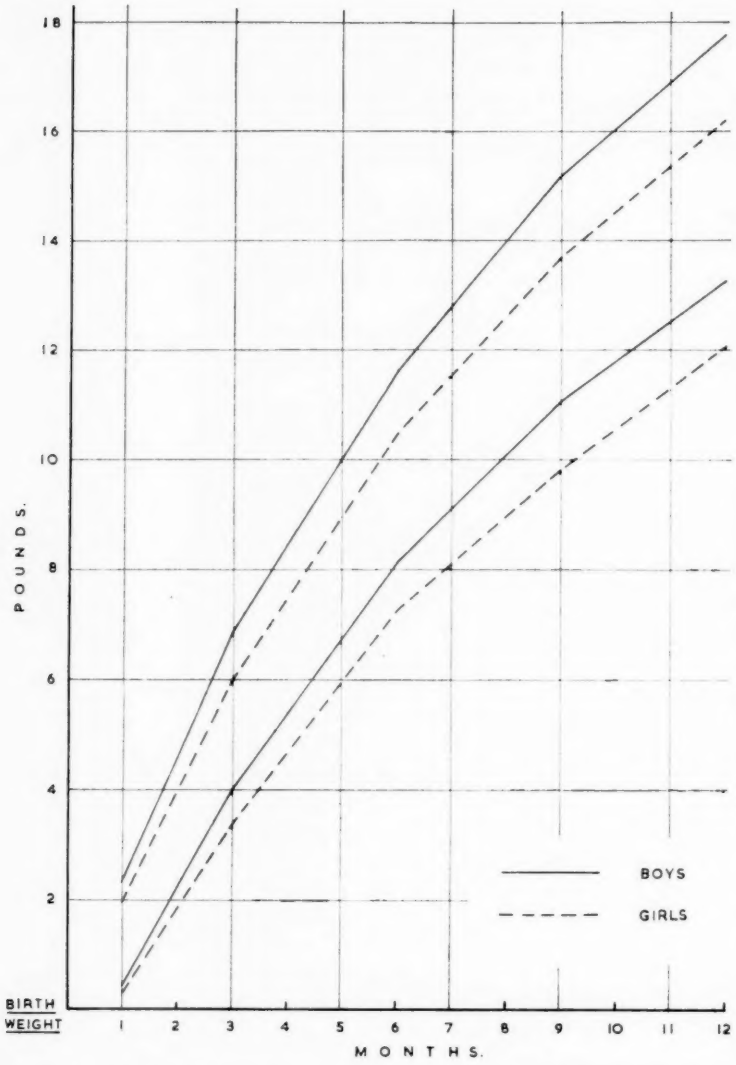

FIG. 2.—Zones* of average weight increment for boys and girls during the first year of life, birth weight taken as zero.

A simple demonstration of the difference between the boys and the girls is given in Table IV and Fig. 2. In the former the average weight increments for each age period have been taken from Table III to make a set of cumulative figures. Here it will be seen that the boys gained a pound more than the girls during the first six months and increased this to 1 lb. 6 oz. by the end of the year.

In Fig. 2 two overlapping zones are shown, one for boys and one for girls. The upper margin of each zone represents the mean cumulative weight increments since birth plus the value of one standard deviation from the mean, and the lower margin the mean cumulative weight increments minus the value of one standard deviation from the mean. In other words, each zone embraces approximately 68 per cent. of the records. In this figure the lines representing the mean values (which are shown in Table IV) have been omitted since their absence makes for clarity.

* This zone includes 68 per cent. of observations.

Finally, the records of John S., one of the boys who attended the Institute of Social Medicine, have been entered beside the averages and standard deviations given in Table IV.

COMPARISON OF ONE BOY WITH THE AVERAGE

Date	Age	Actual Weight		Cumulative Weight Increments		Cumulative Weight Increments (all boys)			
						Average		S.D.	
		lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.
Jan. 1	Birth	5	4						
Feb. 1	1 month	6	0	0	12	1	6	0	15
April 1	3 months	10	0	4	12	5	7	1	7
July 1	6 ,,	15	0	9	12	9	14	1	12
Jan. 1	12 ,,	19	1	13	13	15	8	2	4

If the weight increments of this boy, which do not differ by more than one standard deviation from the mean increments, had been plotted in the earlier chart (Fig. 2) they would have fallen within the zone taken as normal in spite of the fact that the figures for actual weights are well below the average (see Table I). In other words, although this baby was unusually small he appears to have grown at a normal rate.

TABLE IV

CUMULATIVE WEIGHT INCREMENTS IN THE FIRST YEAR OF LIFE
BOYS AND GIRLS

Period	Average Increments							
	Boys (662)				Girls (620)			
	Average		S.D.		Average		S.D.	
	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.
Birth–1 month ..	1	6	0	15	1	2	0	13
Birth–3 months ..	5	7	1	7	4	11	1	5
Birth–6 months ..	9	14	1	12	8	14	1	10
Birth–9 months ..	13	2	2	1	11	12	1	15
Birth–12 months ..	15	8	2	4	14	2	2	1

COMPARISON OF PRESENT FINDINGS WITH OTHER RECORDS

(1) There is a household dictum, widely quoted in medical and nursing text-books, to the effect that " a baby should double its birth weight in five to six months, and treble it in a year " (Paterson, 1947; Garrod, Batten, and Thursfield, 1947;

Mitchell, 1949; Meering, 1947). In Table V the weights recorded in the present investigation are compared with those which would be expected from this formula. With three exceptions the figures obtained in the present investigation give average weights at six months which exceed the expected weights. At twelve months the differences between the two sets of figures are even greater; the observed values ranging from 5 lb. above, to 6 lb. below, the expected amount.

TABLE V

WEIGHTS IN THE FIRST YEAR OF LIFE

(C) COMPARISON OF OBSERVED AND "EXPECTED"* WEIGHTS AT 6 AND 12 MONTHS FOR BOYS AND GIRLS IN SIX BIRTH-WEIGHT GROUPS

Group Number	Average Birth Weight (boys and girls together)		Totals	Average Weights							
				6 months				12 months			
				Actual		Expected*		Actual		Expected*	
	lb.	oz.		lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.
5	4	15	Boys (25)	14	5	9	14	19	15	14	13
			Girls (33)	14	9			19	7		
6	6	2	Boys (83)	16	4	12	4	21	15	18	6
			Girls (96)	15	7			20	4		
7	7	1	Boys (193)	17	3	14	2	22	5	21	3
			Girls (213)	16	0			21	6		
8	7	15	Boys (197)	17	14	15	14	23	9	23	13
			Girls (195)	16	11			22	0		
9	8	14	Boys (126)	18	9	17	12	24	7	26	10
			Girls (69)	17	6			22	8		
10	9	15	Boys (38)	19	7	19	14	25	8	29	13
			Girls (14)	18	11			23	15		

* "Expected" weight at 6 months = Birth weight $\times 2$
"Expected" weight at 12 months = Birth weight $\times 3$.

(2) The National Association for Maternity and Child Welfare publishes a chart for use in Welfare Clinics on which a line marked "normal weight (approximate only)" runs from $7\frac{1}{4}$ lb. at birth through $14\frac{1}{2}$ lb. at six months to $21\frac{1}{4}$ lb. at one year. In Figs 3 and 4 (opposite) this is shown as a horizontal line crossing the centre of the diagram. Cutting across it at various points are a series of shaded areas representing the main bulk of the records for each of the birth-weight groups in the present series (i.e. all values lying within ± 2 standard deviations from the means). In this way it is possible to compare the observed weights

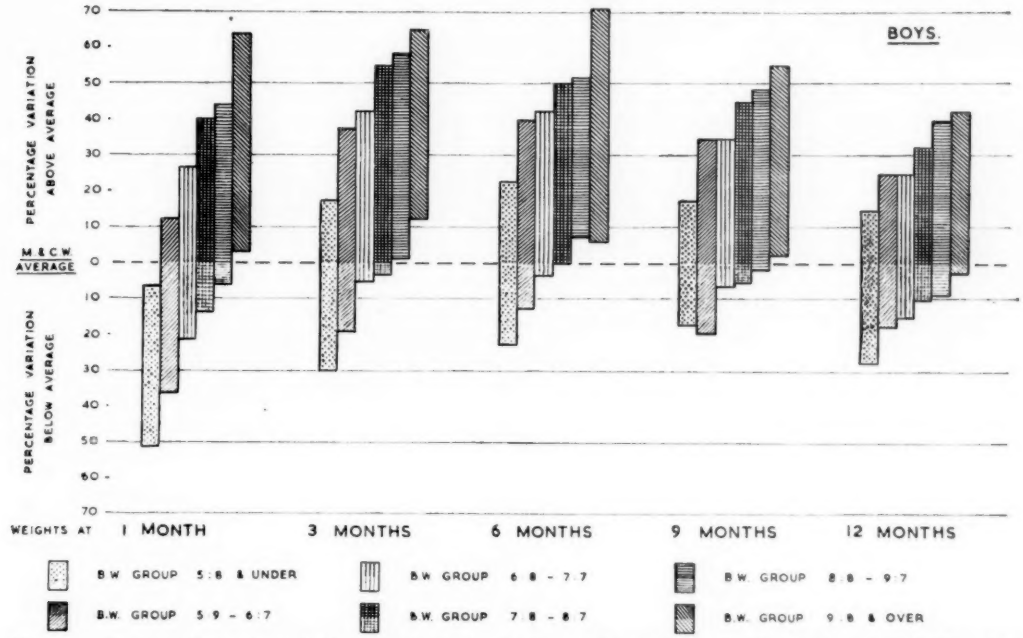
BOYS.
PERCENTAGE VARIATION ABOVE AVERAGE
M & C.W. AVERAGE
PERCENTAGE VARIATION BELOW AVERAGE
70 60 50 40 30 20 10 0 10 20 30 40 50 60 70
WEIGHTS AT 1 MONTH 3 MONTHS 6 MONTHS 9 MONTHS 12 MONTHS
B.W. GROUP 5:8 & UNDER
B.W. GROUP 5:9 - 6:7
B.W. GROUP 6:8 - 7:7
B.W. GROUP 7:8 - 8:7
B.W. GROUP 8:8 - 9:7
B.W. GROUP 9:8 & OVER

FIG. 3.—Comparison of weight range* of six birth-weight groups in the first year of life with standard used by the National Association for Maternity and Child Welfare (*boys* only).

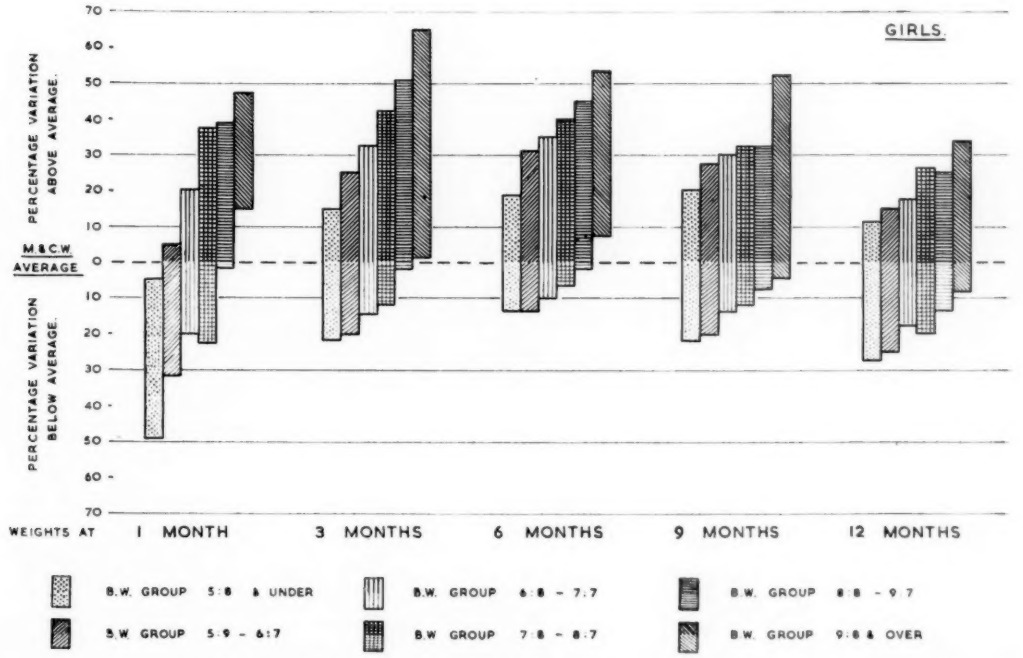
GIRLS.
PERCENTAGE VARIATION ABOVE AVERAGE.
M & C.W. AVERAGE
PERCENTAGE VARIATION BELOW AVERAGE.
70 60 50 40 30 20 10 0 10 20 30 40 50 60 70
WEIGHTS AT 1 MONTH 3 MONTHS 6 MONTHS 9 MONTHS 12 MONTHS
B.W. GROUP 5:8 & UNDER
B.W. GROUP 5:9 - 6:7
B.W. GROUP 6:8 - 7:7
B.W. GROUP 7:8 - 8:7
B.W. GROUP 8:8 - 9:7
B.W. GROUP 9:8 & OVER

FIG. 4.—Comparison of weight range* of six birth-weight groups in the first year of life with standard used by the National Association for Maternity and Child Welfare (*girls* only).

* This range includes 95 per cent. of observations.

for the boys and girls with the so-called " normal weight " record of a baby weighing 7¼ lb. at birth.

According to this demonstration, the range of weights at 3 months and 6 months for boys in Group 7 (average birth weight 7 lb. 2 oz.) extends from 42 per cent. above to 5 per cent. below the average line. For girls in Group 7 it extends from 32 per cent. above to 15 per cent. below at 3 months, and from 35 per cent. above to 10 per cent. below at 6 months. In other birth-weight groups even greater deviations from the horizontal line can be seen. In other words, a majority of the records obtained in the present investigation differ markedly from the so-called " normal weight "; first because the latter makes no allowance for sex difference; secondly because it assumes that *the rate of growth* (as opposed to the actual weight increments) is independent of birth weight, and thirdly because it does not fit the mean values for boys and girls in Group 7, although it is supposed to indicate the average weights of a baby weighing 7 lb. at birth.

(3) Paterson (1947) makes this statement:

> By the 10th or 12th day, the birth weight is regained. Thereafter, from 6 to 8 oz. a week are gained for the first 5 months and about 4 oz. a week from 5 months to one year.

According to these standards, babies should gain from 8 to 11 lb. in the first six months and from 14½ to 17½ lb. in twelve months. This range of values applies to about half the babies in the present series, but 17 per cent. of the boys and 39 per cent. of the girls fell short of the expected range in the first six months, and 31 per cent. and 5 per cent. respectively, exceeded the upper limits at twelve months.

According to another set of figures (Paterson, 1947), the average weight gain during the first six months is 8½ lb. for boys and girls, and during the second six months 5 lb. for boys and 4½ lb. for girls. These figures also differ from the findings of the present investigation, which might be summed up thus:

> Boys gain 10 lb. in the first six months of life and 5½ lb. more in the second; girls gain 9 lb. in the first six months and 5 lb. more in the second. (See Table VI).

TABLE VI

WEIGHT GAINS IN THE FIRST YEAR OF LIFE FOR BOYS AND GIRLS AT QUARTERLY, MONTHLY, AND WEEKLY INTERVALS

Period	Average Weight Gains											
	Boys						Girls					
	Quarterly		Monthly		Weekly		Quarterly		Monthly		Weekly	
	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.
2 weeks–3 months ..	5	7	1	13	0	8	4	11	1	9	0	7
3–6 months	4	7	1	8	0	5½	4	3	1	6	0	5
6–9 months	3	4	1	1	0	4	2	14	0	15	0	3½
9–12 months	2	6	0	13	0	3	2	6	0	13	0	3

Discussion

In order to decide whether a baby is growing satisfactorily it is necessary to have not only serial weight records but also a set of " normal " values with which to compare them. It is then possible to assess progress either by comparing the actual and the " expected " weights at given ages, or by comparing the proportional increase of the actual and expected weights at different ages (i.e. the *rates of growth*). Since the actual weight of a baby during the first year of its life is determined partly by birth weight and partly by sex, it is evident that to assess growth in terms of actual or relative weights it is necessary not only to have a separate set of expected values for boys and girls but also to have separate sets of figures for different birth weights.

Thus a set of standards for absolute and relative weights, based on the present findings, would read as follows for a boy weighing 5 lb. at birth:

10 lb., or twice his birth weight, at three months;
14½ lb., or 2·9 times his birth weight, at six months;
20 lb., or 4 times his birth weight, at a year.

But twelve sets of figures would be required to describe the expected weights if all babies were grouped in six birth-weight groups (1-lb. intervals), 24 sets if classed in twelve groups (½-lb. intervals), and so on.

It is, however, possible to assess progress in another way, namely by recording *weight increments* or the actual amount of weight gained in a given period of time. For clinic purposes this method has a two-fold advantage over the others. In the first place the figures recorded are not affected by differences in birth weight, and secondly, if our findings are typical, " normal " weight increments between one month and twelve months are approximately the same for large and small babies. It is therefore possible to formulate a set of expected values in which a single figure for each age period represents the mean value for all babies of the same sex. A range of expected values can also be indicated by stating the standard deviation from the mean, as well as the mean value. In practice, however, it would probably be simpler to have a chart (similar to that shown in Fig. 2) on which the birth weight is recorded as zero and the normal or expected range of values for weight increments is indicated by a zone. Armed with such a chart even an inexperienced observer could decide whether or not a baby was gaining weight satisfactorily.

Summary

(1) A study of growth during the first year of life is described in which serial weight records of 1,282 babies born in Oxford between 1944 and 1948 are analysed in relation to sex and birth weight.

(2) The rate of growth was found to be greater for boys than for girls, and greater for small babies than for large.

(3) These differences appeared to be due to the fact that weight increment (i.e. actual amount of weight gained since birth) is a function of sex but not of size

for the boys and girls with the so-called " normal weight " record of a baby weighing 7¼ lb. at birth.

According to this demonstration, the range of weights at 3 months and 6 months for boys in Group 7 (average birth weight 7 lb. 2 oz.) extends from 42 per cent. above to 5 per cent. below the average line. For girls in Group 7 it extends from 32 per cent. above to 15 per cent. below at 3 months, and from 35 per cent. above to 10 per cent. below at 6 months. In other birth-weight groups even greater deviations from the horizontal line can be seen. In other words, a majority of the records obtained in the present investigation differ markedly from the so-called " normal weight "; first because the latter makes no allowance for sex difference; secondly because it assumes that *the rate of growth* (as opposed to the actual weight increments) is independent of birth weight, and thirdly because it does not fit the mean values for boys and girls in Group 7, although it is supposed to indicate the average weights of a baby weighing 7 lb. at birth.

(3) Paterson (1947) makes this statement:

> By the 10th or 12th day, the birth weight is regained. Thereafter, from 6 to 8 oz. a week are gained for the first 5 months and about 4 oz. a week from 5 months to one year.

According to these standards, babies should gain from 8 to 11 lb. in the first six months and from 14½ to 17½ lb. in twelve months. This range of values applies to about half the babies in the present series, but 17 per cent. of the boys and 39 per cent. of the girls fell short of the expected range in the first six months, and 31 per cent. and 5 per cent. respectively, exceeded the upper limits at twelve months.

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2 weeks–3 months ..	5	7	1	13	0	8	4	11	1	9	0	7
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Discussion

In order to decide whether a baby is growing satisfactorily it is necessary to have not only serial weight records but also a set of " normal " values with which to compare them. It is then possible to assess progress either by comparing the actual and the " expected " weights at given ages, or by comparing the proportional increase of the actual and expected weights at different ages (i.e. the *rates of growth*). Since the actual weight of a baby during the first year of its life is determined partly by birth weight and partly by sex, it is evident that to assess growth in terms of actual or relative weights it is necessary not only to have a separate set of expected values for boys and girls but also to have separate sets of figures for different birth weights.

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(i.e. birth weight) and, other things being equal, tends to be the same for all babies of the same sex between the ages of one month and one year.

(4) The latter finding suggests a simple yard-stick of growth which could be incorporated in the progress charts used in Infant Welfare Clinics.

My thanks are due to Dr. Mary Fisher, Senior Assistant Medical Officer in charge of Maternity and Child Welfare to the City of Oxford, and to Miss M. B. Wood, S.R.N., S.C.M., Superintendent of the Oxford Mothercraft Clinic, for granting me access to their records. I should also like to record my gratitude to Dr. Alice Stewart, Acting Director of the Institute of Social Medicine, for her constant encouragement and help in the preparation of this paper, and to my other colleagues in the Institute for their assistance. The figures were drawn by Mr. L. E. Griffith.

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SPREAD OF TUBERCULOSIS FROM HOUSE TO HOUSE

BY

JOSEFINE WEBB* and ALICE STEWART

WITH A STATISTICAL APPENDIX BY

IAN SUTHERLAND

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This investigation originates from an observation made in 1948 that many tuberculous patients in Northampton lived next door to one another. It was decided to find out whether the pattern of the disease in this town suggested that persons living next door to tuberculous subjects are unduly prone to contract the disease.

The first step was to discover the position of houses from which cases of tuberculosis had been notified from 1921 to 1948. We next studied other possible influences on the pattern of the disease, to see whether, allowing for these, the position of the affected houses suggested a random distribution of cases, or revealed the transmission of disease between neighbours. Finally, to decide whether the setting of the investigation was exceptional, the population and social conditions of Northampton were examined, by comparing the borough as a whole with other towns, and by comparing different districts within the borough.

1. Medical Survey

Tuberculosis Notifications. Northampton County Borough, 1921-1948.—Between January 1, 1921, and December 31, 1948, notifications of tuberculous disease of the lungs, meninges, and other sites were received from 2,871 houses, or approximately one in every ten houses in the borough (see Table I). Of every ten cases notified, eight were pulmonary and two non-pulmonary (total 3,346).†

(*a*) *Age and Sex.*—Throughout the period of study the tuberculosis death rate for Northampton County Borough has followed the same trend as the rate for England and Wales as a whole, and fatal cases have shown a similar age and sex distribution. Between 1938 and 1948—the only period for which notification

* In receipt of a grant from the Medical Research Council.

† Tuberculosis notifications from houses demolished before or built after 1936, and cases included in the official register of tuberculosis notifications but subsequently removed as "diagnosis not established", are not included in the present investigation. All post-mortem diagnoses are included. Throughout the period of study Dr. Laughton, Chest Physician to Northampton County Borough, has been in sole charge of the tuberculosis records.

TABLE I

TUBERCULOSIS NOTIFICATIONS. NORTHAMPTON 1921-1948

COMPARISON BETWEEN CASE INCIDENCE AND HOUSE INCIDENCE

Group	Disease Category	No. of Cases	Annual Rate per 10,000
Notified Persons	Pulmonary	2,674	9·8
	Miliary and meningeal	164	0·6
	Other sites	508	1·9
	Total	3,346	12·4
Affected Houses	Pulmonary	2,340	31·2
	Miliary and meningeal	160	2·1
	Other sites	496	6·6
	Total	2,871*	38·3

* In 119 houses there were cases of tuberculosis belonging to two different categories (e.g. pulmonary and meningeal or pulmonary and other sites) and in three houses there were cases belonging to all three categories. Hence this figure is 125 less than the sum of the figures in the same column.

TABLE II

TUBERCULOSIS NOTIFICATIONS (PERSONS OVER THE AGE OF 14 YEARS). NORTHAMPTON 1921-1939
OCCUPATIONAL ANALYSIS

Occupational Group	Males		Females	
	No. employed*	Tuberculosis notifications rate per 10,000 per annum	No. employed*	Tuberculosis notifications rate per 10,000 per annum
Professional and clerical	4,064	11·1	2,755	13·7
Retail, personal services, and entertainment	5,083	12·3	4,642	9·7
Outdoor occupations	4,645	10·3	107	—
Basic industries	1,212	14·8	—	—
Light assembly	3,956	14·9	2,285	19·6
Boot and shoe industry	8,871	23·8	5,480	20·3
Non-productive manual labour	1,202	19·7	7	—
Unskilled and not gainfully employed	5,473	9·7	24,308	6·5
Total	34,506	15·3	39,584	12·3

* 1931 Census (persons over the age of 14 years).

records for England and Wales are available—there appears to have been a slight excess of notifications in Northampton. This difference, which is confined to persons between the ages of 15 and 25 years, and to the years 1940 to 1946, is probably due to the fact that the records for England and Wales apply to the civilian population only, whereas those for Northampton include men and women who were serving in the armed forces.

(*b*) *Occupation.*—An occupational analysis of cases over the age of 14 years notified in Northampton between 1921 and 1939 is shown in Table II. This Table,

which does not include cases notified after the outbreak of war, is based on information in the 1931 Census, and shows that the incidence of tuberculosis is higher in the boot and shoe industry than in any of the other large occupational groups—a finding consistent with the Registrar-General's statistics of occupational mortality. (Registrar-General's Decennial Supplement for England and Wales, 1931.)

TABLE III

TUBERCULOSIS NOTIFICATIONS. NORTHAMPTON 1921-1948

COMPARISON OF CASE INCIDENCE IN GOOD, FAIR, AND POOR HOUSES OF CENTRAL AND PERIPHERAL WARDS

Affected houses expressed as a percentage of all houses

Disease Category	Grading of House*	Peripheral Wards*	Central Wards*	All Regions
Pulmonary	Good	5·75	6·46	5·96
	Fair	9·42	9·80	9·62
	Poor	10·76	12·35	11·90
	Total	7·98	9·62	8·74
Other Sites	Good	1·76	1·42	1·69
	Fair	2·63	2·48	2·57
	Poor	4·82	3·58	3·95
	Total	2·39	2·45	2·42
Total All Cases	.. .. ..	9·94	11·68	10·72

* See p. 23 for definitions of good, fair, and poor houses, and of central and peripheral wards.

(*c*) *Houses.*—The electoral wards and houses in Northampton in which cases of tuberculosis occurred are shown in Tables III and X, the wards being grouped in two classes (*central* and *peripheral*) and the houses in three (*good*, *fair*, and *poor*).*

The case incidence shows the usual social gradient, being highest in the poor and lowest in the good houses, and slightly higher in the central than in the peripheral zone. Only 82 of the 640 streets in the town of Northampton remained free from tuberculosis during the period of study. These streets were fairly evenly distributed throughout the town and showed no tendency to concentrate in the better-class districts.

In deciding whether the position of houses from which tuberculosis notifications had been received gave evidence of spread of infection between neighbours, two points had to be considered: the spatial arrangement of the affected houses, and the time relationships of the cases.

* See Section 2 (Sociological Survey) for a definition of good, fair, and poor houses and for a general description of the electoral wards included in the peripheral and central zones of Northampton. The houses were classified by Dr. Laughton and the tuberculosis health visitor, Miss C. Reese, S.R.N. (both of whom have worked in the Tuberculosis Dispensary for Northampton County Borough for over 20 years).

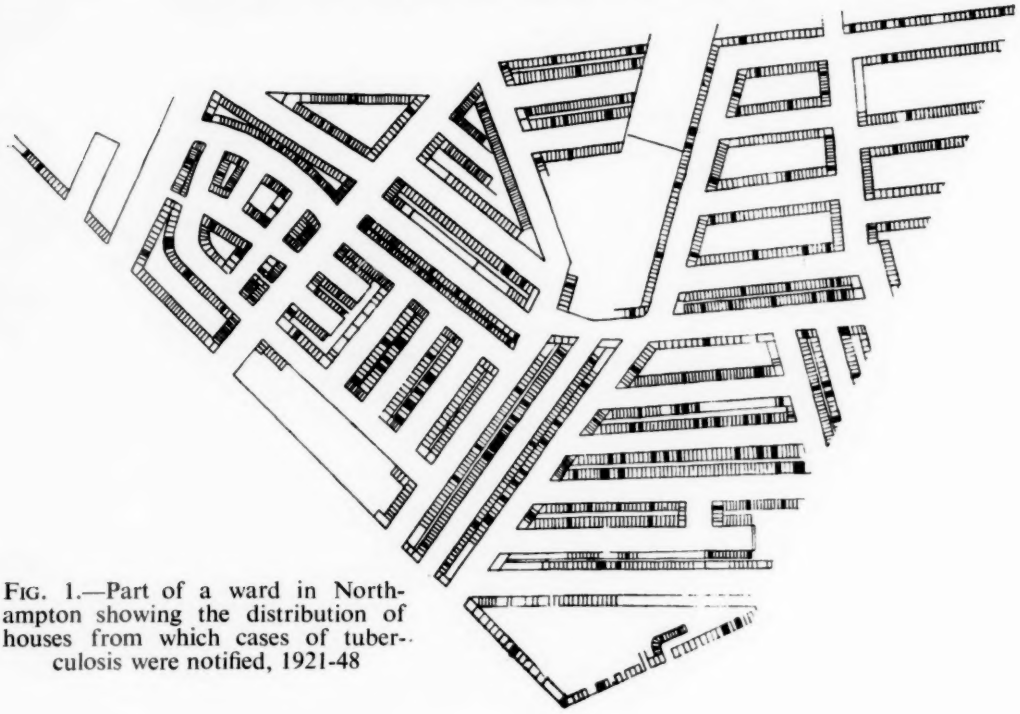

FIG. 1.—Part of a ward in Northampton showing the distribution of houses from which cases of tuberculosis were notified, 1921-48

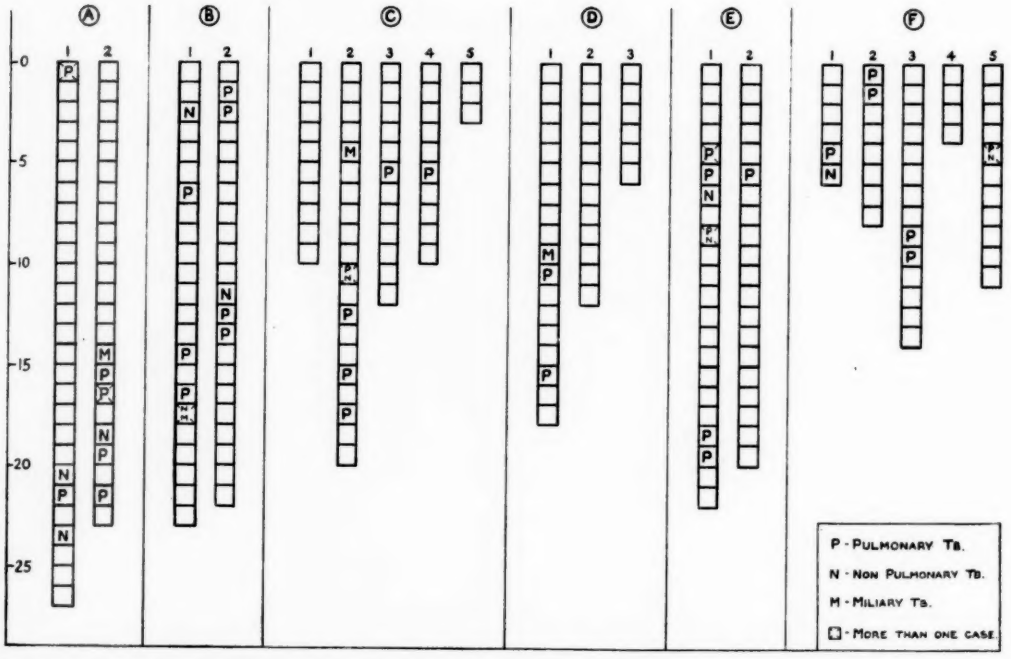

FIG. 2.—Position of affected houses in nineteen rows of houses in six streets, Northampton 1921-1948.

SPATIAL ARRANGEMENT OF AFFECTED HOUSES.—The affected houses in one of the central wards in Northampton are shown in Fig. 1. They are widely scattered, but it is far from certain that they do not tend to be more closely grouped together than if they were randomly distributed. To decide, therefore, whether the number of next-door pairs exceeds expectation, more must be known about the laws governing their chance distribution than can be gleaned from a straightforward inspection of a map. The mathematical theory of the random distribution of points in one dimension has already been intensively studied; and by extending the results of this work and applying new formulae (see Statistical Appendix) to the present data, more may be said about the linear arrangements of the affected houses than would otherwise have been possible.

To make the necessary calculations the following facts had to be assembled:

(i) the total number of uninterrupted rows of dwelling-houses in the town;
(ii) the number of houses in each of these rows or " sections ";
(iii) the disposition of the affected houses in each section. The recording system is shown diagrammatically in Fig. 2.

In both the central and peripheral zones of the town a few long streets contained more than one type of house, but in neither region did the division of houses into good, fair, and poor classes involve the division of any continuous row of domestic buildings.

It was then possible to count the number of occasions in which notifications had been received from next-door pairs of houses (Table IV). Other " pairs " of affected houses (separated by 1, 2, 3, 4, or 5 unaffected houses) were also included in the calculations. Since subsequent analysis of the " separated pairs " revealed little of medical interest, no further mention of these houses will be made in this part of the paper, but detailed findings are given in the Tables and in the Statistical Appendix.

The results of the calculations based on these facts are shown in Table V (overleaf) and Table XII (p. 29). In the former the observed incidence of next-door pairs of affected houses is expressed as a percentage of the expected incidence (see Statistical Appendix).

TABLE IV

TUBERCULOSIS NOTIFICATIONS. NORTHAMPTON 1921-1948

SPATIAL RELATIONSHIPS OF CASES IN NEXT-DOOR HOUSES, ETC.

I. Numerical incidence of next-door pairs of affected houses, etc.

Position of Notifications	Pulmonary Tuberculosis	Pulmonary with Meningeal and Miliary Tuberculosis	All Types
Relationship of Houses			
Next door	231	264	353
Next door but one	182	204	286
Next door but two	191	209	279
Next door but three	157	174	236
Next door but four	144	167	219
Next door but five	117	132	187
Number of Houses			
Total affected houses	2,340	2,461	2,871
No. of affected houses in pairs or runs	442*	501*	668*
Percentage next-door houses in pairs or runs of all affected houses	18·9	20·4	23·3

* This figure is less than twice the number of next-door houses because in some instances a series of three or more adjacent houses were affected. In these longer series the number of houses involved is only one more than the number of pairs.

According to Table V, the number of next-door pairs is greater than the number which would have occurred by chance.* The difference between the observed and expected numbers in the linear series is only slightly affected by the type of case contained in the houses. Thus, if all types of tuberculosis are grouped together, the next-door pairs exceed expectation by 19 per cent.; if pulmonary tuberculosis is taken alone, the excess is 16 per cent.; and if pulmonary, miliary, and meningeal cases are grouped together and other non-pulmonary cases omitted, it is 20 per cent.

TABLE V

TUBERCULOSIS NOTIFICATIONS. NORTHAMPTON 1921-1948

SPATIAL RELATIONSHIPS OF CASES IN NEXT-DOOR HOUSES, ETC.

II. Comparison of observed and expected relationships. Next-door pairs, etc., of affected houses expressed as a ratio of the expected number of next-door pairs, etc. (N.B.—In each cell the expected number = 100)

Position of Notifications	Pulmonary Tuberculosis	Pulmonary with Meningeal and Miliary Tuberculosis	All Types
Next door	116	120	119
Next door but one or two	106	106	106
Next door but three or four	100	103	100
Next door but five ..	89	91	89

TIME RELATIONSHIPS OF CASES IN NEARBY HOUSES.—The notification dates were then examined to see whether the cases situated in the same or nearby houses were more closely related in time than would be expected from chance alone. The intervals between the years of notification of pairs of cases occurring in the same or nearby houses were enumerated, and the data analysed in three groups:

(i) all types of tuberculosis;
(ii) pulmonary, miliary, and meningeal;
(iii) pulmonary tuberculosis alone.

The time intervals between pairs of cases occurring in the same house, next-door houses, and houses next-door-but-one, etc., were enumerated separately (Tables VI, VII, opposite, and XIII, p. 32).

Table VI shows that, within a period of 12 years, second notifications from the same house were far more frequent that second notifications from next-door houses. Table VII shows that even from next-door houses second notifications exceed the number expected, the findings being only slightly affected by the type of case contained in the house. Thus, for all forms of tuberculosis the number of second cases in next-door houses exceeds expectation by 27 per cent.; for pulmonary tuberculosis the excess is 33 per cent.; and for pulmonary, meningeal, and miliary it is 35 per cent.

COMPARISON OF CASES IN NEXT-DOOR HOUSES WITH CASES OCCURRING ELSEWHERE.—Thus far the findings suggest that there has been a tendency for tuberculosis to occur more often and in a shorter space of time in next-door houses than would have been the case had it been randomly distributed. On the face of it this

* This calculation ignores the relative position of affected houses on opposite sides of a street, and only concerns the houses from which cases were first notified. Subsequent addresses could not be taken into account since dates of removal and periods of residence at the new addresses were not known.

TABLE VI

TUBERCULOSIS NOTIFICATIONS. NORTHAMPTON 1921-1948

TIME RELATIONSHIPS OF CASES IN NEXT-DOOR HOUSES, ETC.

I. Numerical incidence of second notifications occurring before and after 12 years

Position of Cases	Pulmonary Tuberculosis			Pulmonary with Meningeal and Miliary Tuberculosis			All Types		
	Time Interval			Time Interval			Time Interval		
	0-12 years	Over 12 years	Total	0-12 years	Over 12 years	Total	0-12 years	Over 12 years	Total
Same house ..	318	65	383	361	75	436	442	99	541
Next door ..	214	90	304	245	104	349	324	150	474
Next door but one	164	71	235	182	85	267	255	130	385
Next door but two	141	85	226	153	97	250	215	127	342

TABLE VII

TUBERCULOSIS NOTIFICATIONS. NORTHAMPTON 1921-1948

TIME RELATIONSHIPS OF CASES IN NEXT-DOOR HOUSES, ETC.

II. Second notifications occurring within 12 years expressed as a ratio of the expected number. (N.B.—In each cell the expected number = 100.)

Position of Cases	Pulmonary Tuberculosis	Pulmonary with Meningeal and Miliary Tuberculosis	All Types
Same house	345	348	304
Next door	133	135	127
Next door but one ..	110	109	109
Next door but two ..	103	99	100

suggests that " neighbourly contact " is one of the social customs responsible for spreading the disease. But before deciding that this was the only factor responsible for the present findings, it was necessary to compare the cases occurring in next-door pairs of houses with those found elsewhere, and a study was made of the age, social class, housing conditions, and family history of tuberculosis of the two groups of cases. The case histories were also scrutinized to discover how many of the patients living next door to other cases were related to one another (Table VIII, overleaf).*

According to this analysis the only significant differences are those in respect of social class I and good houses. Since day-to-day contact between neighbouring

* Since it is difficult to trace all female relationships, owing to the change of surname on marriage, a special survey of all patients still on the register was also made to discover whether two or more patients living next door to one another were related. This drew a complete blank.

TABLE VIII

PULMONARY TUBERCULOSIS NOTIFICATIONS. NORTHAMPTON 1921-1948

Comparison of Age, Social Class, Housing Conditions, and Family History* of Cases in Next-door Pairs of Houses and Other Houses

Relationship of Houses		Next-door Houses	Other Houses
Age Group (years) ..	0–14	2·0	2·9
	15–24	31·1	30·5
	25–44	41·7	43·0
	5+4	25·2	23·5
Social Class (males only)	I and II	4·6	9·2
	III	79·6	72·3
	IV and V	14·4	16·0
	Unclassified	1·4	2·5
Housing Conditions ..	Good	14·3	23·0
	Fair	68·1	62·9
	Poor	17·5	14·0
Family History of Tuberculosis*		28·0	27·5
No. of Tuberculosis Subjects (not living in the same house) known to be related to one another		2	9

* Restricted to grand-parents, parents, siblings, and offspring.

households is undoubtedly least in the least congested and wealthiest sections of the community, any transmission of infection should also be least in the best residential districts and in the highest income groups. Only two of the patients in the next-door pairs of affected houses were found to be related to one another, compared with nine in the remainder. These two figures are proportional to the total number of houses in the two groups (see Table IV).

2. SOCIOLOGICAL SURVEY

SOCIOLOGICAL FEATURES OF NORTHAMPTON COUNTY BOROUGH

(*a*) *Population.*—Between 1921 and 1948 there was an increase in the total number of inhabitants and a decrease in the proportion of children and adolescents living in Northampton. These and other population changes are similar to those which were occurring elsewhere in England and Wales.

(*b*) *Trades and Occupations.*—Shoemaking has long been the staple industry of Northampton; in 1921, and again in 1931, approximately 33 per cent. of the working population were employed in the boot and shoe industry and 5 per cent. in the leather-dressing trade. Engineering works, clothing factories, and breweries absorbed about 10 per cent. of all wage-earners up to 1939; there are no miners, quarrymen, or potters, and a negligible number of textile workers; the proportion of clerical workers, tradesmen, storekeepers, builders, and transport workers

(approximately 30 per cent. of all wage-earners) is similar to that in other manufacturing towns.

(*c*) *Economic Status.*—According to the periodic surveys of the hours of work and earnings of manual workers made since 1924 (Ministry of Labour Gazette, 1924-1946), male shoemakers over the age of 20 tend to earn less than skilled artisans in other trades. This has had a direct bearing on the earnings of men belonging to social class III (skilled artisans) in Northampton and has reduced these below par, but there have been no major strikes in the boot and shoe industry since 1921 and very little unemployment. Other workers in the industry (women and juveniles) have always been relatively well paid, and even before 1939 a greater proportion of women were wage-earners in Northampton than elsewhere. Thus, the average income of all persons living in Northampton was slightly above par during the inter-war years. Since then there have been no air raids, virtually no unemployment, and an increase in the number of female wage-earners. It is likely, therefore, that throughout the period of study the economic position of Northampton has been relatively good.

(*d*) *Vital Statistics.*—For many years the vital statistics of Northampton County Borough have shown a favourable trend, and the infant, maternity, tuberculosis, and general death rates have declined *pari passu* with those of England and Wales as a whole. The improvement in the infant mortality rate is less than that recorded for England and Wales, but this is because from 1921 to 1925 there were only 59 deaths for every 1,000 live births in Northampton, whereas the corresponding rate for England and Wales was 76. By 1948 both rates had declined to 36.

To compare Northampton directly with other county boroughs the following statistics were examined:

(i) Social class distribution of males over the age of 14 (Registrar-General's Statistical Review, 1934. P. 144, Table XCVII).
(ii) Standardized mortality rates (males), 1931-1934 (calculated from figures published in the Registrar-General's Statistical Reviews).
  (*a*) all causes;
  (*b*) pulmonary tuberculosis.
(iii) Statutory overcrowding (i.e. households with more than two persons per room). (1931 Census).
(iv) Poor relief (i.e. persons in receipt of poor relief per 1,000 of the population, 1931-1933). (Hart and Wright, 1939).

In Table IX (overleaf) an unweighted average for each of these indices is shown for the county boroughs of England and Wales (arranged in five size groups) and for Northampton. In 1931 the following points were to be noted with regard to Northampton:

(i) the proportion of skilled manual workers (social class III) was above average;
(ii) the standardized mortality ratios for all causes of death and for pulmonary tuberculosis for males over 14 years of age were below average;
(iii) statutory overcrowding was conspicuously low;

(iv) poor law relief was high compared with other towns of the same size, but did not exceed the average for all county boroughs.

On the whole, therefore, these statistics show that Northampton is favourably placed when compared with other county boroughs.

TABLE IX

ENGLISH COUNTY BOROUGHS (1931 CENSUS) COMPARED WITH NORTHAMPTON

English County Boroughs		Average population	Males					Housing Data				Poor Relief†
			Social class			Standardized mortality ratio		Persons per room	Persons per acre	Persons per dwelling	Houses overcrowded* %	
Size groups (by population)	No.		I and II	III	IV and V	All causes	Pulmonary tuberculosis					
Under 65,000	15	54,000	14	50	36	107	103	0·83	13	4·0	7·6	21
,, 90,000	17	76,054	12	51	37	109	107	0·85	17	4·2	7·2	34
,, 120,000	16	104,815	15	51	34	113	109	0·86	19	4·0	8·2	28
,, 200,000	15	152,747	12	53	35	112	119	0·88	23	4·3	7·9	33
Over 200,000	16	421,733	13	51	36	115	135	0·89	27	4·2	8·6	45
Total	79	162,264	13	51	36	111	115	0·86	20	4·1	7·9	33
NORTHAMPTON		92,314‡	14	61	25	93	90	0·70	27‡	3·9	2·0	33

* i.e. with more than two persons per room.

† Persons in receipt of poor relief per 1,000 of the population (1931-1933).

‡ In March 1932 the boundaries of Northampton County Borough were extended, increasing the acreage from 3,469 to 6,201 and the population from 92,341 to 96,546.

INTERNAL STRUCTURE OF NORTHAMPTON COUNTY BOROUGH.—To identify the size, nature, and position of the buildings and open spaces in a town, a street directory and an ordnance survey map are required. The cases of tuberculosis considered in this paper have therefore been restricted to those from houses standing in 1936—the only year for which a complete street directory for Northampton was available. There were then 26,769 occupied dwelling-houses and 96,300 inhabitants, and the borough boundary enclosed 6,201 acres. The town was divided into twelve electoral wards, seven with county borders (*peripheral* zone) and five surrounded by other wards (*central* zone). The houses in the central zone were more congested than those in the peripheral zone, but according to the records of the tuberculosis dispensary (which apply only to patients) there appeared to be a fairly even distribution of good, fair, and poor houses in most districts.

In classifying the houses in the borough, two or three rows of houses, described by the health visitor as *fair*, were identified in each ward. The health visitor and the chest physician to the borough (both of whom have worked in the tuberculosis

TABLE X

NORTHAMPTON. SOCIOLOGICAL DATA

Zone	Ward	Estimated Population	Houses			Persons per House	Total Acreage per House	Restricted Acreage per House	Tuberculosis notifications 1921-1948 per 1,000 houses
			Good	Fair	Poor				
Peripheral	1	6,967	2,924	147	—	2·3	3·5	9·8	5·6
	2	4,197	1,061	735	—	2·3	2·8	7·3	5·3
	3	6,033	810	1,194	—	3·0	3·0	10·8	8·1
	4	8,405	545	1,669	86	3·7	3·6	13·7	9·7
	5	7,271	289	1,584	137	3·6	3·4	19·1	7·7
	6	7,995	169	1,552	152	4·3	1·9	17·0	10·6
	7	6,296	144	466	433	6·0	1·5	17·1	10·7
	Total	47,164	5,942	7,347	808	3·3	2·8	11·9	8·0
Central	8	8,692	962	1,284	188	3·6	5·3	11·5	7·6
	9	7,566	727	1,532	5	3·3	16·3	25·2	8·7
	10	10,800	712	2,139	143	3·6	16·6	19·7	8·8
	11	11,498	57	2,339	520	3·9	19·4	24·6	10·9
	12	10,832	—	831	1,233	5·2	11·5	32·2	12·3
	Total	49,388	2,458	8,125	2,089	3·9	11·5	19·6	9·6
All Regions		96,552	8,400	15,472	2,897	3·6	4·3	14·6	8·7

dispensary for over 20 years) were then asked to mark the remaining houses as follows:

(i) those which corresponded to the standard houses (*fair*);
(ii) those with better amenities (*good*);
(iii) those with worse amenities (*poor*).

In this way 36 more or less homogeneous groups were defined, corresponding to the three types of house in each ward.

When all the houses had been graded it was found that there were three wards in the peripheral zone with no poor houses and one in the central zone with no good houses. In nine wards (five peripheral and four central) there was a majority of fair houses, and in two peripheral wards a majority of good houses. Only one central ward had a majority of poor houses (Table X).

Since the built-up area of the town did not extend to the borough boundary,* the housing density, as judged by houses per acre, appeared to be very much greater in the peripheral than in the central zone.

When, however, the open country within the boundary but outside the built-up area, and all non-residential buildings and inaccessible open sites (e.g. railway sidings) were excluded, the difference between the peripheral and central wards was

* This was extended in 1932 and the acreage increased from 3,469 to 6,201. As a result of this extension the 1931 population of 92,341 was increased to 96,546.

found to be much less. With this alternative index, a fairly close correlation was found between (i) density of houses and order of merit in terms of good, fair, and poor, and (ii) density of houses and tuberculosis notification rate per ward (Table X).

The general amenities of Northampton compare favourably with those of other manufacturing towns of the same size, and the tuberculosis findings are unlikely to have been biased by exceptional social conditions. The absence of large pockets of extreme wealth and extreme poverty, and the fact that open country and large parks are easily accessible from all parts of the town, probably explains why the introduction of regional (i.e. ward) subdivisions into the mathematical calculations produced very little alteration in the " expected number of pairs of next-door houses affected with tuberculosis ". On the other hand it is impossible to regard the town as a homogeneous unit. The division of the houses into three classes is, in the context, an attempt to classify the social and economic status of houses in the same way as the Registrar-General has classified the social and economic status of persons; but, although this served the main purpose of the present investigation, there is an obvious need for more objective standards.

3. Discussion

Deeny (1947) attempted to decipher the pattern of tuberculosis in a manufacturing town of 15,000 inhabitants by studying the arrangement of affected houses over a period of 25 years. He concluded that " the main factor which enables the disease to spread and cause deaths is the residence of adolescents in near proximity to, or neighbourly contact with, a case which dies ".

The present investigation has much in common with its predecessor, but covers a slightly longer period and makes no distinction between fatal and non-fatal cases of tuberculosis. It relates to a population largely composed of workers in one industry, but since the town is much larger (approximately 100,000 inhabitants) the investigation has had to allow for variations in social amenities and types of house in different parts of the town. Instead of relying on visual impressions to decide whether the affected houses show a tendency to aggregation or clumping, a more objective assessment of the findings has been attempted.

From 1921 to 1948 the social amenities and economic status of the inhabitants of Northampton were relatively good, but the town itself experienced many changes. Old houses were demolished, new houses built, and new industries established; no building was damaged during the second world war, but many of the inhabitants were called up for national service, large numbers of evacuees were temporarily accommodated, and many residents changed their addresses.

All these changes tend to blur the pattern of a disease which moves slowly and leaves behind only an imperfect record of its course, and to reduce to a minimum the " positive findings " of an investigation based on a comparison of observed and expected relationships, ignoring the movement of persons from house to

house, and restricting the definition of a neighbour to " a person living in an adjacent house on the same side of the street ". Nevertheless, the faint outline of a pattern has been discerned which is apparently due not to social, economic, or occupational factors, nor to an exceptionally large number of related persons in next-door houses, but to the spread of the disease between neighbours. Exactly what contribution this mode of spread, which appears to be due to infective and not to genetic factors, has made to the total amount of overt tuberculosis it is impossible to say; but it is certainly no less and possibly much greater than that which has been shown to exist.

The work of Stocks (1935) only came to our notice after this paper was in proof. He studied the frequency of deaths from cancer in the same house and in neighbouring houses by methods in essence identical with those developed independently for this study of tuberculosis. He found that:

> Cancer deaths tend to occur in pairs more frequently in the same or adjacent houses than would be expected if the population at risk was distributed uniformly in the houses and the deaths took place at random in the population. . . . An exactly similar study of the distribution of persons aged 55 to 75 . . . shows . . . precisely the same result. . . . To postulate any theory of infection to " explain " the curious distribution of cancer deaths in houses is therefore redundant, since it can be sufficiently explained by the tendency to segregation in the same or adjacent houses of people of those ages at which cancer death is of most frequent occurrence.

It may well be asked whether these tuberculosis figures can be similarly dismissed. It is not possible to test the point explicitly in the way that Stocks did, owing to the destruction by fire in 1942 of the 1931 Census records. But tuberculosis is not nearly so restricted in its age-incidence as is cancer. Consequently its pattern will be less affected by any uneven distribution of population by age in the same or nearby houses. Moreover, Stocks found " no conclusive evidence that when cancer deaths occur in pairs in the same or neighbouring houses there is any tendency for them to be separated by a short rather than a long interval ". The undue preponderance of pairs of cases of tuberculosis occurring within a short period of years in the same and next-door houses is a distinctive feature of the present data, and supports our contention that tuberculosis may spread from one house to that next door.

SUMMARY

The present investigation was undertaken to discover whether persons living next door or near to a tuberculous subject run more risk of contracting the disease.

The investigation was based on statistics for Northampton, which is comparable in standards of living and population structure to other towns of the same size in England and Wales.

Over a period of 28 years (1921 to 1948) notifications of tuberculosis were reported from 2,871 houses standing in the borough in 1936. Approximately

20 per cent. of the affected houses were grouped in pairs or in runs of three or more.

The number of next-door pairs of houses which would have been affected had the cases been distributed at random was calculated by means of formulae derived from the mathematical theory of the random distribution of points in one dimension. Allowance was made for differences between good, fair, and poor housing, but only the interrelationships of houses on the same side of a street were taken into consideration.

The number of affected houses standing next door to one another was found to be significantly greater than the number to be expected had the cases been randomly distributed.

When the time relationships of the cases were investigated it was found that for any period up to 12 years the number of pairs of cases reported from the same house and from next-door houses was significantly in excess of the number to be expected from pure chance.

There is no evidence that these findings are due to there being an exceptionally large number of related persons living next door to one another.

Our sincere thanks are due to Dr. N. B. Laughton and the staff of the Northampton Health Clinic, whose help and careful record-keeping have made this survey possible.

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STATISTICAL APPENDIX

BY

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The problem of assessing whether the pattern of tuberculosis in affected houses is random or not is of some statistical interest. In the first place, considerable care has to be taken to cast the actual data into a form which can validly be compared with a theoretical model. Secondly, an extension of existing mathematical theory is necessary for this model. The interest lies in the inter-action between the theoretical and practical sides of the problem. It will be studied in two stages:

(*a*) if there is spread of the disease from one house to another there will be an undue clustering of affected houses *in space*;

(*b*) there will also be an undue tendency for neighbouring cases of the disease to cluster *in time*.

Spatial Pattern of Affected Houses

Each street was first divided into " sections " (rows of houses on the same side of a street uninterrupted by non-domestic buildings, or by side streets). These sections varied in size from one to eighty houses. The average number of houses per section was 13·9. The prime purpose of this division was to reduce a mathematically awkward two-dimensional to a tractable one-dimensional problem, but it also groups the houses in conformity with the accepted notion of a row of neighbouring houses.

It was next necessary to assess the clustering of affected houses. One method was to determine how many " runs " of two, three, four, or more affected houses occurred. This had the disadvantage that there were few runs of more than two. In all the 2,871 affected houses there were only 29 runs of three affected houses, three of four, and one of five. Also this method took no cognizance of any clustering which did not result in actual runs. It was therefore decided to assess clustering by enumerating " interval-pairs " (pairs of affected houses in the same street-section standing a stated number of doors away from each other). These were enumerated for intervals of 1, 2, 3, 4, 5, and 6 houses. The totals had then to be compared with the numbers to be expected if the distribution of affected houses were random.

Mathematical Theory.—The probability distributions of points on a line were studied extensively by Krishna Iyer (1948). He did not, however, consider the concept of an interval-pair except in the case of an interval of one (a " black-black join "). The theory can be extended to include the general interval-pair by applying the formulae given by Moran (1948). If the probability of a house being affected is p in a section of

n houses, then the first two moments of the distribution of the number of pairs of affected houses which are r doors away from each other are given by the formulae:

$$\mu_1' = (n-r)p^2 \qquad \text{if } r = 1 \ \ldots\ldots\ n-1$$

$$\mu_2 = (n-r)p^2 + 2(n-2r)p^3 - (3n-5r)p^4 \quad \text{if } r = 1 \ \ldots\ldots\ \left[\frac{n-1}{2}\right]$$

$$\mu_2 = (n-r)p^2 - (n-r)p^4 \qquad \text{if } r = \left[\frac{n+1}{2}\right] .. \ n-1$$

The third and fourth moments have also been derived, but are considerably more complicated, both in their form and in the boundary conditions.

If there is a group of s sections for which p is constant, the average length of the section being $\bar{n}$, the first two moments of the total number of pairs of affected houses and doors apart are seen to be:

$$\mu_1' = s(\bar{n}-r)p^2 \qquad \text{if every } n \text{ satisfies } r = 1 \ \ldots\ldots\ n-1 \qquad \text{(i)}$$

$$\mu_2 = s(\bar{n}-r)p^2 + 2s(\bar{n}-2r)p^3 - s(3\bar{n}-5r)p^4 \quad \text{if every } n \text{ satisfies } r = 1 \ \ldots\ldots\ \left[\frac{n-1}{2}\right] \qquad \text{(ii)}$$

$$\mu_2 = s(\bar{n}-r)p^2 + s(\bar{n}-r)p^4 \qquad \text{if every } n \text{ satisfies } r = \left[\frac{n+1}{2}\right] .. \ n-1$$

These boundary conditions for μ_2 are very inconvenient, particularly when r is large. This is the principal reason why pairs were not enumerated for $r > 6$. The following approximate procedure has been adopted in the ensuing analysis of groups of sections. The population value of p has been estimated by the ratio of affected houses to all houses in the group of sections analysed. The expected totals of affected pairs one to six doors away from each other have been calculated from formula (i) for all sections for which $r \leqslant n-1$. The variances have been calculated from formula (ii), with the parameters appropriate to all sections for which $r \leqslant n-1$. These variances will be overestimated, but since sections for which $\left[\frac{n-1}{2}\right] < r \leqslant n-1$ will be in a minority except for large r, the approximation will affect the estimate only slightly; in any case the tests of significance will err on the side of caution. The tests were made on the assumption that the number of interval-pairs is normally distributed.

One further point remains. Formulae (i) and (ii) are valid only if p is constant throughout the group of s sections. It is thus necessary to divide the street sections into suitable groups before analysing the data, and then to sum the results. Originally the data were arranged in 32 separate groups, representing the good, fair, and poor houses in each of the twelve electoral wards (there were no good houses in one ward and no poor houses in three). It was clearly desirable, however, because of the computations involved, to handle fewer groups, provided that no serious discrepancy arose by so doing. As a trial, therefore, the expected numbers of next-door pairs of affected houses were calculated for each of the 32 groups separately, and also for various amalgamations of them. The findings are presented in Table XI. The arrows in this table show that the effect of progressive subdivision of relatively large groups of data into smaller and more nearly homogeneous groups is to increase the expected numbers of next-door pairs of affected houses. It will be seen, however, that the introduction of regional subdivisions (vertical arrows) produces relatively little increase in the expected numbers compared with the subdivision into good, fair, and poor housing (diagonal arrows). On these findings, it was decided that it would be sufficiently accurate to analyse the data in three groups, classified according to standard of housing. The resulting "expected" numbers are, however, rather lower than if it had been possible to account for all local variations in the incidence of tuberculosis.

TABLE XI

TUBERCULOSIS NOTIFICATIONS. NORTHAMPTON 1921-1948

EXPECTED NUMBERS OF NEXT-DOOR PAIRS OF AFFECTED HOUSES

Groups of Houses Regarded as Homogeneous*	Number of Homogeneous Groups in Northampton	Expected Numbers of Next-door Pairs
Whole town	1	189·2
Good, fair, and poor houses	3	198·8
Central and peripheral districts	2	190·9
Housing within districts	6	199·1
Electoral wards	12	198·4
Housing within wards	32	204·3
Actual number of next-door pairs	=	231

* In this context a homogeneous group is defined as one in which it is assumed that all the houses are equally liable to be affected.

FINDINGS.—The data were analysed in three stages (see Table XII):

(*a*) houses containing only cases of pulmonary tuberculosis;
(*b*) houses containing cases of pulmonary, miliary or meningeal tuberculosis;
(*c*) houses containing any type of tuberculosis.

TABLE XII

TUBERCULOSIS NOTIFICATIONS. NORTHAMPTON 1921-1948

SPATIAL RELATIONSHIPS

Comparison of Actual and Expected Numbers of Interval-Pairs of Affected Houses
(Based on a separate analysis of good, fair, and poor houses)

Disease Category		Relationship of Affected Houses					
Houses affected with		Next door	Next door but 1	2	3	4	5
Pulmonary Tuberculosis	Actual	231	182	191	157	144	117
	Expected	198·8	182·8	169·4	155·8	143·6	131·0
	Difference ..	32·2	−0·8	21·6	1·2	0·4	−14·0
	S.E. of Diff. ..	15·1	14·4	13·8	13·1	12·5	11·9
	Diff./S.E. ..	2·1	−0·1	1·6	0·9	0·0	− 1·2
Pulmonary, Miliary, or Meningeal Tuberculosis	Actual	264	204	209	174	167	132
	Expected	220·5	202·9	187·8	172·6	158·9	144·8
	Difference ..	43·5	1·1	21·2	1·4	8·1	−12·8
	S.E. of Diff. ..	16·0	15·2	14·5	13·9	13·2	12·5
	Diff./S.E. ..	2·7	0·1	1·5	0·1	0·6	− 1·0
Any Type of Tuberculosis	Actual	353	286	279	236	219	187
	Expected	297·4	274·3	254·2	234·0	215·7	197·0
	Difference ..	55·6	11·7	24·8	2·0	3·3	−10·0
	S.E. of Diff. ..	18·7	17·8	17·0	16·2	15·5	14·7
	Diff./S.E. ..	3·0	0·7	1·5	0·1	0·2	− 0·7

For houses affected with pulmonary tuberculosis, the number of next-door pairs was 231, compared with the expected value of 198·8. The excess is just greater than twice its standard error, and may be adjudged significant. None of the differences between actual and expected numbers of other interval-pairs is significant. Similar conclusions apply to houses affected with pulmonary, miliary, or meningeal tuberculosis, and also to houses affected with any form of tuberculosis. The excesses over expectation of next-door pairs become progressively more significant as more forms of tuberculosis are included, but none of the findings for intervals of more than one even approaches a significant level.

This analysis has taken no cognizance of the effects of movement of population, since only the house from which the disease was notified has been regarded as affected. If, however, a house containing a case of tuberculosis is liable to lead to a case in a neighbouring house, then the removal of the patient to another house removes one source of danger, but creates another elsewhere. The effect of this would probably be to increase the relative frequency of apparently scattered cases of tuberculosis, and so to obscure rather than exaggerate any danger there may be in living next door to a person suffering from tuberculosis.

This influence, and that of further subdivision of the data into smaller and more homogeneous groups (Table XI), are both imponderable. Since, however, they appear to have the opposite effect on the " expected " figures they will to some extent cancel one another out. In any case, the next-door pairs appear to be in a category distinct from pairs at greater intervals. It therefore seems justifiable to conclude that there is some evidence of tuberculosis having passed from one house to the next.

Pattern of the Disease in Time

It was a natural extension of the above analysis to proceed from the consideration of houses affected with tuberculosis to the actual cases of the disease, and to see whether those which had arisen in the same or nearby houses were more closely related in time than would be expected from chance alone.

The intervals between the years of notification of every pair of cases occurring in the same or near-by houses were enumerated. (If more than one case was notified from a house in one year, this was treated, for theoretical reasons, as a single notification.) Four separate enumerations were made of pairs of cases occurring in the same house, in houses next door, next door but one, and next door but two. These totals had then to be compared with the numbers to be expected if the distribution of time-intervals were random.

Mathematical Theory.—Theoretically this reduces to a distribution problem of points on a rectangular lattice, the lattice being the experience of a " section " of n houses over m successive years. Since there were substantial fluctuations in the annual notifications of tuberculosis it is necessary to consider a lattice on which the probability that a point is affected varies along the time-dimension of the lattice, a configuration not previously studied. Let p_j be the probability that tuberculosis is notified from a given house in a section of n houses in the year $j(j=1 \ldots . m)$. Then the first two moments of the

distribution of pairs of notifications separated by an interval of t years, and occurring r doors away from each other, are given by the formulae:

$$\mu_1' = 2(n-r)\sum_{j=1}^{m-t} p_j p_{j+t} \text{ if } r=1\ldots.n-1;\quad t=1\ldots.m-1.$$

μ_1' = half this quantity if $r=1\ldots.n-1$; $t=0$.
or $r=0$; $t=1\ldots.m-1$.
or $r=t=0$.

$$\mu_2 = 2(n-r)\sum_{j=1}^{m-t} p_j p_{j+t} + 2(n-2r)\sum_{j=1}^{m-t} p_j^2\, p_{j+t} + 2(n-2r)\sum_{j=1}^{m-t} p_j p_{j+t}^2$$
$$+ 4(2n-3r)\sum_{j=1}^{m-2t} p_j p_{j+t}\, p_{j+2t} - 2(3n-5r)\sum_{j=1}^{m-t} p_j^2\, p_{j+t}^2$$
$$- 4(2n-3r)\sum_{j=1}^{m-2t} p_j p_{j+t}^2\, p_{j+2t}$$

if $r=1\ldots.\left[\frac{n-1}{2}\right]$; $t=1\ldots.m-1$.

μ_1 = half this quantity if $r=1\ldots.\left[\frac{n-1}{2}\right]$; $t=0$.
or $r=0$; $t=1\ldots.m-1$.

$$\mu_2 = n\sum_{j=1}^{m} p_j^2 \quad \text{if } r=t=0.$$

If there is a group of s sections, each with the same values of p_j, the average length of section being $\bar{n}$, the first two moments of the total number of pairs of notifications separated by t years, and r doors away from each other, are given by the formulae:

$$\mu_1' = 2s(\bar{n}-r)\sum_{j=1}^{m-t} p_j p_{j+t} \text{ if every } n \text{ satisfies } r=1\ldots.n-1; \text{ and } t=1\ldots.m-1 \qquad \text{(iii)}$$

μ_1' = half this quantity if every n satisfies $r=1\ldots.n-1$; and $t=0$.
or $r=0$; and $t=1\ldots.m-1$.
or $r=t=0$. (iv)

$$\mu_2 = 2s(\bar{n}-r)\sum_{j=1}^{m-t} p_j p_{j+t} + 2s(\bar{n}-2r)\sum_{j=1}^{m-t} p_j^2\, p_{j+t} + 2s(\bar{n}-2r)\sum_{j=1}^{m-t} p_j p_{j+t}^2$$
$$+ 4s(2\bar{n}-3r)\sum_{j=1}^{m-2t} p_j p_{j+t}\, p_{j+2t} - 2s(3\bar{n}-5r)\sum_{j=1}^{m-t} p_j^2\, p_{j+t}^2$$
$$- 4s(2\bar{n}-3r)\sum_{j=1}^{m-2t} p_j p_{j+t}^2\, p_{j+2t}$$

if every n satisfies $r=1\ldots.\left[\frac{n-1}{2}\right]$; and $t=1\ldots.m-1$ (v)

μ_2 = half this quantity if every n satisfies $r=1\ldots.\left[\frac{n-1}{2}\right]$; and $t=0$.
or $r=0$; and $t=1\ldots.m-1$. (vi)

$$\mu = s\bar{n}\sum_{j-1}^{m} p_j^2 \quad \text{if } r=t=0. \qquad \text{(vii)}$$

In applying these formulae the following approximations and assumptions were made. The values of p_j were assumed to be constant throughout all sections with good housing, and fair housing, and poor housing; the expectations and variances for the three groups were added after the calculations had been made. The values of p_j were estimated by the ratio of all notifications during the year j to the number of houses in the particular group of sections. Expectations and variances were calculated from formulae (iii) to (vii) with the parameters appropriate to all sections for which $r \leqslant n-1$. The variances will be, as before, slightly overestimated by formulae (v) and (vi), and so the tests of significance will err on the side of caution. These tests were made on the assumption that the numbers of pairs are normally distributed.

TABLE XIII

TUBERCULOSIS NOTIFICATIONS. NORTHAMPTON 1921-1948

RELATIONSHIPS IN TIME

Comparison of Actual and Expected Numbers of Pairs of Cases, according to the Time-Interval between the Notifications in the Same or Neighbouring Houses
(Based on a separate analysis of good, fair, and poor houses)

Disease Category	Time Interval (years)	Relationship of Affected Houses							
		Same House		Next Door		Next Door but One		Next Door but Two	
		Actual	Expected	Actual	Expected	Actual	Expected	Actual	Expected
Pulmonary Tuberculosis	0–3	179	37·87*	84	60·49*	66	55·83	55	51·45
	4–7	99	30·06*	67	55·68	58	51·36	47	47·34
	8–11	40	24·24*	63	44·89*	40	41·41	39	38·18
	12–15	34	19·62*	36	36·35	25	33·56	35	30·93
	16–19	22	15·28	27	28·32	24	26·12	26	24·07
	20–23	6	10·44	20	19·33	19	17·82	16	16·44
	24–27	3	4·13	7	7·64	3	7·04	8	6·47
	All intervals	383	141·64*	304	252·70*	235	233·14	226	214·88
Pulmonary, Miliary, or Meningeal Tuberculosis	0–3	210	42·83*	97	68·46*	77	63·15	60	58·18
	4–7	104	33·58*	77	62·16	62	57·33	51	52·80
	8–11	47	27·24*	71	50·43*	43	46·52	42	42·86
	12–15	38	22·03*	42	40·84	31	37·70	41	34·75
	16–19	26	17·12*	31	31·71	28	29·24	28	26·94
	20–23	7	11·61	21	21·48	22	19·81	20	18·28
	24–27	4	4·53	10	8·38	4	7·72	8	7·12
	All intervals	436	158·94*	349	283·46*	267	261·47	250	240·93
Any Type of Tuberculosis	0–3	250	59·24*	132	94·75*	102	87·39	85	80·51
	4–7	130	47·97*	100	88·78	88	81·88	69	75·43
	8–11	62	38·14*	92	70·64*	65	65·17	61	60·04
	12–15	48	30·61*	57	56·68	46	52·28	58	48·18
	16–19	33	23·53	49	43·60	48	40·24	33	37·09
	20–23	14	15·42	28	28·57	30	26·33	25	24·27
	24–27	4	5·61	16	10·30	6	9·48	11	8·74
	All intervals	541	220·52*	474	393·32*	385	362·77	342	334·26

* The difference between observed and expected numbers exceeds twice the standard error. Each standard error is slightly greater than the square root of the expected number, but in no instance by more than 3 per cent

FINDINGS.—The data relating to time intervals were also analysed in three stages, first for cases of pulmonary tuberculosis, then for cases of pulmonary, miliary, or meningeal tuberculosis, and finally for any form of tuberculosis. For each of these groups of cases, the time-relations in the same house, in houses next door, next door but one, and next door but two, were studied, and the results are summarized in Table XIII (previous page).

The observed numbers of pairs of cases occurring in the same house substantially (and significantly) exceed the expected numbers for intervals up to 15 years; the figures are suggestive of an excess after an interval of 16-19 years, but for longer intervals the differences are unimportant. This is true for each of the three groups of cases. The finding confirms the known fact that tuberculosis may continue to spread between members of a household over a period of years.

The experience in next-door houses shows an excess over expectation for intervals of less than 12 years, which attains significance for each of the three disease groups. For intervals of 12 years and over there is no important difference between the observed and expected figures. This more detailed analysis confirms the slight tendency shown above for tuberculosis to pass from one house to that next door, and gives the further information that this method of transmission of the disease may take up to 12 years to manifest itself. Comparison of the observed and expected figures for houses two or three doors away from each other shows no significant differences for any interval of time.

In conclusion, therefore, there is evidence of a slight tendency for tuberculosis to pass from one house to that next door within a period of 12 years from the detection of the original case. The analysis also confirms the known fact that tuberculosis is liable to spread among members of a household. This effect may be observed for intervals up to 15 years.

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RISK OF STILLBIRTH IN TWIN PREGNANCY RELATED TO SEX AND MATERNAL AGE

AN ANALYSIS OF 90,386 TWIN MATERNITIES

BY

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It is well known that in every country with reliable vital statistics more male than female children are born each year, and that the sex ratio of stillbirths is considerably higher than that of related live births. By means of data from the Annual Reports of the Registrar-General for England and Wales and for Scotland it has recently been demonstrated (Lowe and McKeown, 1950) that the sex ratio of total births decreases with maternal age, whereas the sex ratio of stillbirths increases. It was suggested that this relationship to age is due to changes in the relative proportions in each maternal age group of different causes of stillbirth, each of which has its own sex ratio.

Since July, 1938, the Annual Reports of the Registrar-General for England and Wales have presented the results of twin maternities by sex, type of birth (live or stillborn), and maternal age, although cause of stillbirth is unfortunately not recorded. Between July, 1938, and December, 1948, 90,730 twin maternities were notified, for 344 of which maternal age was not specified. We are unaware of any reference in the literature to the sex of twin stillbirths in relation to the age of the mother, and this communication presents an analysis of 90,386 twin maternities for which the necessary data are available.

TABLE I

SEX RATIOS OF SINGLE AND TWIN STILLBIRTHS RELATED TO MATERNAL AGE
(England and Wales, July, 1938, to December, 1948)

Type of Stillbirth		Maternal Age (years)							Total Stillbirths*
		Under 20	20–24	25–29	30–34	35–39	40 and Over	All Ages*	
Single ..	Percent. Male ..	51·2	52·8	53·8	54·3	54·0	54·5	53·74	209,428
	Standard Error ..	±0·6	±0·3	±0·2	±0·2	±0·3	±0·4	±0·11	
Twin ..	Percent. Male ..	60·4	57·1	54·9	55·8	54·7	54·1	55·56	11,292
	Standard Error ..	±3·0	±1·1	±0·9	±0·9	±1·0	±2·0	±0·47	

* In this and all subsequent Tables (except Table IV), 6,138 single and 114 twin stillbirths, for which maternal age was unspecified, have been excluded.

Sex Ratios of Twin Stillbirths and Single Stillbirths Compared

The sex ratio* of twin stillbirths (55·56) is higher than that of single stillbirths (53·74) and the difference (1·82±0·48) is highly significant. This difference, however, is not the same at all maternal ages; the sex ratio of single stillbirths increases regularly with advancing maternal age, whereas twin stillbirths show a fairly consistent decrease (see Table I and Fig. 1).

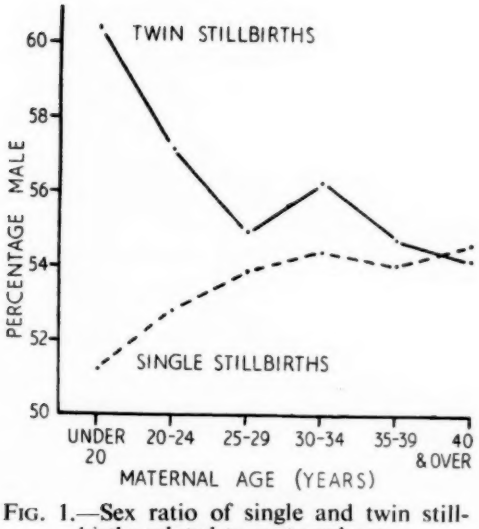

FIG. 1.—Sex ratio of single and twin stillbirths related to maternal age.

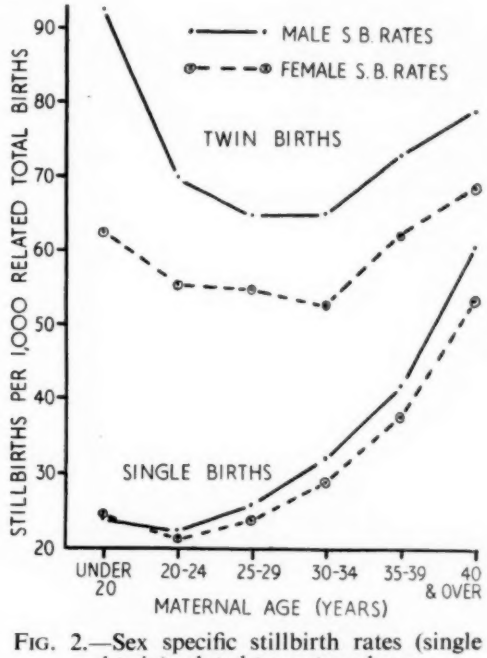

FIG. 2.—Sex specific stillbirth rates (single and twin) related to maternal age.

Before proceeding to a more detailed examination of this difference, we should note that a direct comparison of the numbers of male and female stillbirths (i.e. the sex ratio) is influenced by the related number of total births, as it does not take into account the respective numbers of each sex at risk. A more precise measure of sex difference is provided by relating the number of male and female stillbirths in each maternal age group to the number of male and female foetuses at risk in that age group. Sex specific stillbirth rates are given in Table II (overleaf, see also Fig. 2 above), and we may note that:

(1) At all ages, stillbirth rates are higher in twin births than in single births. The difference is very much greater in the younger than in the older mothers.

(2) For twin births, male stillbirth rates are consistently higher than female rates (particularly in the case of younger mothers).

(3) For single births, there is little difference between the male and female stillbirth rates of young mothers, but as maternal age increases the risk to the male foetus becomes progressively greater than the risk to the female.

* The sex ratio is expressed as the percentage of males $\left(\frac{M}{M+F} \times 100\right)$.

TABLE II

SEX SPECIFIC STILLBIRTH RATES* (SINGLE AND TWIN) RELATED TO MATERNAL AGE
(England and Wales, July, 1938, to December, 1948)

Type of Stillbirth		Maternal Age (years)							Total Stillbirths
		Under 20	20–24	25–29	30–34	35–39	40 and Over	All Ages	
Single ..	Male	23·7	22·1	25·5	31·8	41·5	60·1	29·7	112,539
	Female	24·2	21·0	23·3	28·5	37·4	53·0	27·2	96,889
Twin	Male	92·1	69·9	64·6	64·8	72·4	78·5	68·2	6,274
	Female	62·3	55·1	54·8	53·3	61·9	68·1	56·5	5,018

* Rates are expressed as the number of stillbirths per 1,000 related total births
(e.g. sex specific still-birth rate of twin males $= \frac{\text{Number of twin male still-births}}{\text{Total number of twin males}} \times 1{,}000$).

In short, in young mothers the risk of stillbirth is much higher for twins than for single births; the increased risk is particularly marked in the case of males. In older mothers the increased risk though still present is greatly reduced, being about the same for males and females.

STILLBIRTH RATES IN LIKE- AND UNLIKE-SEX TWIN MATERNITIES

A separate examination of stillbirth rates of monozygous and dizygous twins cannot be made unless we accept the assumptions implicit in the method of twin identification described by Weinberg (1903). This method has frequently been used to give the incidence of monozygous and dizygous twins by maternal age, but its use in the calculation of stillbirth rates involves assumptions which are open to criticism. We can, however, separate two groups:

(i) monozygous and dizygous pairs (like-sex)
(ii) dizygous pairs only (unlike-sex).

The following points emerge when stillbirth rates are calculated for these two groups by maternal age (see Table III and Fig. 3, opposite):

(1) Stillbirth rates for like-sex pairs are consistently higher than for unlike-sex pairs.
(2) At all maternal ages the risk to the male foetus, in both like- and unlike-sex pairs, is considerably higher than the risk to the female.
(3) Unlike-sex twin stillbirth rates are lowest for mothers under 25 years and, as in the case of single births, increase with maternal age. Stillbirth rates for like-sex twins have the same relation to maternal age as the rates for all twins, and are lowest in the middle of the reproductive period.

In interpreting the age trend of the stillbirth rate of like-sex twins the following points may be noted:

TABLE III

SEX SPECIFIC TWIN STILLBIRTH RATES (LIKE- AND UNLIKE-SEX PAIRS) RELATED TO MATERNAL AGE
(England and Wales, July, 1938, to December, 1948)

Type of Twin Stillbirth		Maternal Age (years)						Total Stillbirths
		Under 25*	25–29	30–34	35–39	40 and Over	All Ages	
Like-sex	Male	80·8	70·3	70·1	78·3	81·3	74·4	4,443
	Female	62·0	60·6	58·2	66·6	71·9	61·9	3,497
Unlike-sex	Male	51·0	53·8	55·9	63·0	73·5	56·7	1,831
	Female	41·7	44·4	45·3	54·8	61·3	47·1	1,521

* Numbers do not justify separation of stillbirths to mothers under 20 years from stillbirths to mothers aged 20-24 years.

(*a*) Like-sex twins include both monozygous and dizygous pairs.
(*b*) The proportion of monozygous pairs changes with maternal age, and is lowest in the middle of the reproductive period. (Jenkins, 1927; Guttmacher, 1937; Yerushalmy and Sheerar, 1940; Waterhouse, 1950.)
(*c*) The fact that stillbirth rates are consistently higher for like-sex than for unlike-sex twins suggests that stillbirth rates are also higher for monozygous than for dizygous twins.

If conclusion (*c*) is justified, and if dizygous like- and unlike-sex pairs have similar stillbirth rates, a possible explanation of the increased stillbirth rates of like-sex twins at low and high ages may be suggested. They may be accounted for by the greater incidence of monozygous twins, and may be compatible with a monozygous stillbirth rate which, though higher, exhibits the same age trend as unlike-sex stillbirths.

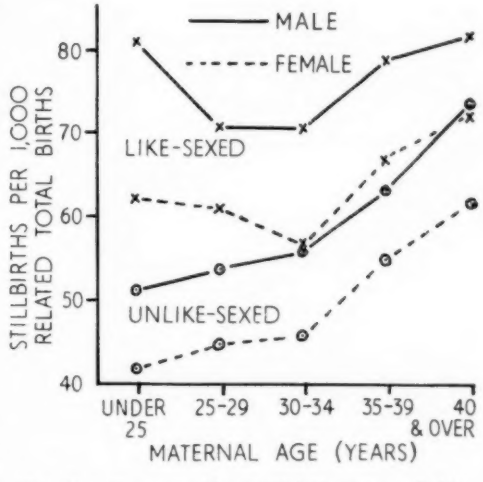

FIG. 3.—Sex specific stillbirth rates of like- and unlike-sex twins.

STILLBIRTH RATES IN SINGLE, TWIN, AND TRIPLET MATERNITIES

Further support for the belief that stillbirth rates are higher for monozygous than for dizygous pairs is available in Table IV (overleaf). Stillbirth rates are here given for individuals (male or female) occurring alone in single maternities, or in association with other foetuses (of like or different sex) in multiple maternities. Although the numbers are small in the case of triplets, the results for the two sexes are (with one exception) quite consistent.

TABLE IV

SEX SPECIFIC STILLBIRTH RATES IN SINGLE, TWIN, AND TRIPLET MATERNITIES
(England and Wales, July, 1938, to December, 1948)

Type of Maternity	Male Propositus		Female Propositus	
	Associated in uterus with	Stillbirth rates of propositi	Associated in uterus with	Stillbirth rates of propositi
Single	—	30·4±0·1	—	27·8±0·1
Twin with One of Opposite Sex	F	56·9±1·3	M	47·3±1·2
Triplet with Two of Opposite Sex	FF	60·6±15·7	MM	51·7±16·8
Twin with One of Same Sex	M	75·1±1·1	F	62·2±1·0
Triplet with One of Same and One of Opposite Sex	MF	123·6±17·6	MF	106·1±14·3
Triplet with Two of Same Sex	MM	133·3±14·8	FF	81·9±12·0

As would be expected, stillbirth rates are lowest when the foetus is a single one. Its risk of stillbirth is increased by the presence in the uterus of another individual of different sex (twins) or of two other individuals of different sex (triplets). The stillbirth rate is still higher for foetuses associated with another individual of the same sex (twins) and very much higher when there are two other foetuses of which one or both are of the same sex (triplets).

Since in MF and MFF maternities the male has developed from a separate ovum, and since in MM, MMF, and MMM maternities some of the male pairs have developed from a single zygote, it seems probable that the risk to the foetus in multiple births is directly related to the incidence of monozygosity.

SINGLE AND DOUBLE STILLBIRTHS IN TWIN MATERNITIES

Yerushalmy and Sheerar (1940) have shown that in the United States Birth Registration Area the proportion of like-sex twin maternities resulting in two stillbirths is about twice as great as that of unlike-sex maternities, whereas the proportion of maternities resulting in one live and one stillbirth is about the same for both types of twinning. The data for England and Wales confirm this, if variation in maternal age is disregarded (Table V). When maternal age is taken into consideration, however, certain differences become apparent (Fig. 4). At all ages the proportion of maternities resulting in two stillbirths is more than twice as great for like-sex as for unlike-sex pairs; in the case of twin maternities resulting in one stillbirth, however, like-sex pairs run a greater risk in the younger and a smaller

TABLE V

TYPE OF BIRTH IN LIKE- AND UNLIKE-SEX TWIN MATERNITIES RELATED TO MATERNAL AGE
(England and Wales, July, 1938, to December, 1948)

Type of Birth	Maternal Age (years)										All Ages		
	Under 25		25–29		30–34		35–39		40 and over				
	Like	Unlike	Like	Unlike	Like	Unlike	Like	Unlike	Like	Unlike	Like (*a*)	Unlike (*b*)	Difference (*a*–*b*)
Two Live-born ..	88·8	92·1	89·7	91·5	89·9	91·1	88·6	89·9	87·9	88·4	89·28	91·00	−1·72±0·10
One Live-born, One Still-born	8·0	6·6	7·5	7·2	7·4	7·6	8·3	8·5	8·8	9·8	7·78	7·60	+0·18±0·09
Two Still-born ..	3·2	1·3	2·8	1·3	2·7	1·3	3·1	1·6	3·3	1·8	2·94	1·39	+1·55±0·05
Total ..	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	— —
Maternities on which percentages are based	12,467	5,370	16,974	9,328	15,710	9,484	10,277	6,604	2,688	1,484	58,116	32,270	— —

risk in the older maternal age groups than do unlike-sex pairs ($\chi^2=13\cdot0$, $n=4$, $0\cdot01<p<0\cdot02$).

If attention is confined to like-sex twins (Table VI, overleaf) it is seen that male pairs show a higher proportion with one or two stillbirths than do female pairs. The high risk of the male as compared with the female is particularly evident if the proportions resulting in two stillbirths are compared.

DISCUSSION

In single births it is well known that the risk of stillbirth is higher for the male than for the female foetus. That this is also true for twins is shown by data from the Annual Reports of the Registrar-General for England and Wales. Closer examination, however, indicates that the risk of stillbirth in the male, when compared with the risk in the female, varies both with maternal age and with type of twinning. In investigating these variations, we are unfortunately handicapped by inability to separate monozygous and dizygous pairs (except partially on the basis of like and unlike sex) or to examine

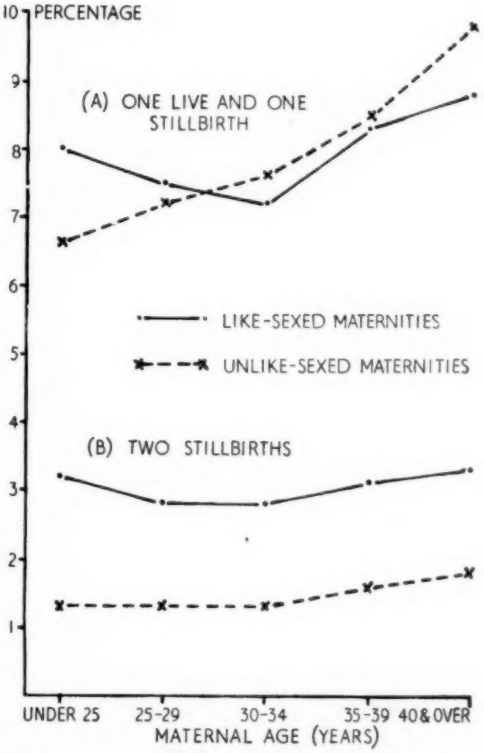

FIG. 4.—Frequency with which like- and unlike sexed twin maternities result in (A) one live and one stillbirth and (B) two still births.

TABLE VI

RISK OF STILLBIRTH IN LIKE-SEX TWIN MATERNITIES

Type of Twin Maternity		Type of Birth			Total
		Two Live-born	One Live-born One Stillborn	Two Stillborn	
Both Male (MM)	%	88·48	8·16	3·36	100·0
	No.	26,411	2,435	1,004	29,850
Both Female (FF)	%	90·12	7·38	2·50	100·0
	No.	25,474	2,087	705	28,266
Total	%	89·28	7·78	2·94	100·0
	No.	51,885	4,522	1,709	58,116

the cause of death. No modest extension of national statistics is likely to provide this information, and any further progress will probably depend on careful and laborious field enquiry.

SUMMARY

Data from the Annual Reports of the Registrar-General for England and Wales (1938-1948) are used to show that:

(1) Whereas the sex ratio of stillbirths in single pregnancies increases with maternal age, the sex ratio of twin stillbirths decreases.
(2) At all ages stillbirth rates are higher in twins than in single births. The difference is very much greater in the younger than in the older mothers.
(3) For twin births, male stillbirth rates are consistently higher than female rates (particularly in the case of younger mothers).
(4) For single births there is little difference between the male and female stillbirth rates of young mothers, but as maternal age increases the risk to the male foetus becomes progressively greater than that to the female.
(5) Stillbirth rates for like-sex pairs are consistently higher than for unlike-sex pairs.
(6) At all maternal ages the risk to the male foetus, in both like- and unlike-sex pairs, is considerably higher than the risk to the female.
(7) Unlike-sex twin stillbirth rates are lowest for mothers under 25 years, and, as in the case of single births, increase with maternal age. Stillbirth rates for like-sex twins have the same relation to maternal age as those for all twins, and are lowest in the middle of the reproductive period.

It is suggested that the risk to the foetus in multiple births is directly related to the frequency of monozygosity. Support for this view is provided by an analysis of sex specific stillbirth rates in single, twin, and triplet maternities.

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STATISTICAL UTILIZATION OF MATERNITY AND CHILD WELFARE RECORDS

BY

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1. Introduction

The collection and analysis of statistical material relating to mortality and morbidity has long been an important part of the functions of Public Health Authorities. Much of the data analysed at a national level is transmitted through the local authority and reciprocal arrangements have developed whereby statistical analysis of its own problems by each authority runs *pari passu* with centralized statistics for the country as a whole. In the field of child welfare, the rapid fall in infant mortality has shifted emphasis on the one hand to the importance of the antenatal period in relation to the hard core of neonatal mortality, and on the other to less immediately lethal aspects of child health. In both these fields local authorities have responsibilities which call for periodic assessment.

The characteristics of Maternity and Child Welfare data of most interest to vital statisticians are that they cover all or nearly all of a complete population in the demographic sense, and that they record first-hand observations of events and conditions which might otherwise be missed. The data are, however, frequently less precise than can be obtained by trained investigators. A brief account of the methods now being adopted by the Maternity and Child Welfare Department of the City of Birmingham will illustrate the scope and limitations of Public Health material, and may be of interest to medical statisticians engaged in comparable tasks.

The Maternity and Child Welfare Department, through its frequent contact with most of the city's mothers and children, has studied intensively aspects of neonatal mortality and the care of immature infants; but a considerable corpus of information collected by midwives and health visitors regarding surviving children has not hitherto been available in a form amenable to systematic analysis. To utilize more effectively all existing data and to meet other administrative needs, the Senior Assistant Medical Officer of Health for Maternity and Child Welfare sought the assistance of the Central Statistical Office in re-designing some of the forms, and in planning a mechanized record system. Thus on January 1, 1949, was inaugurated a new system of records intended to make more readily available the medical and social histories of all children in the city under the age of 5 years. No radical changes in departmental policy or organization were involved, since health visitors were already visiting about 98 per cent. of all births to Birmingham residents at

least once, and no new items of information were asked for; but a considerable effort was made to secure greater precision of definition and more complete coverage.

The Central Statistical Office was materially assisted by investigations carried out in Birmingham and Smethwick by the Department of Social Medicine of the University of Birmingham, as also by the new medical documents designed by the Department of Medical Statistics.

2. Objectives

Two chief motives prompted a change in the form of the records kept. In the first place, it had long been felt both by School Medical Officers and by the Maternity and Child Welfare Department that a link between the department's knowledge of the child's pre-school medical history and its school medical record is highly desirable. This presupposes the availability of one document recording the principal items of the pre-school history in a form suitable for transmission to the school when the child passes out of the care of the department. Secondly, observations on children surviving beyond the first birthday have not been hitherto amenable to statistical analysis, being in fact no longer available after the care of the individual child has ceased.

When the principal items in the antenatal record and subsequent history of the child up to 5 years old are codified in such a way that they can be transferred to a punch card, material for several new lines of enquiry becomes available.

(i) When the antenatal care and type of care at delivery can be directly related to the subsequent history of the infant, a more precise assessment of the effects of public provision on infant welfare can be made.

(ii) The same type of assessment can be made of social conditions affecting the child.

(iii) The direct association between events in the antenatal period and during labour with the subsequent history of the baby permits a relatively novel approach to certain aspects of infant mortality and morbidity.

Needless to say, mortality rates alone do not give a complete picture of the significance of a pathological condition. In addition, fatality, absentee, and disablement rates are required so that resulting deaths are assignable to total incidence of the condition. Evidently, the field in which such an approach is possible is limited to conditions whose total ascertainment is practicable in a given population, e.g. communicable diseases, and army medical statistics. Maternal conditions, e.g. toxaemia, difficult labour, etc., are frequently recorded as the main or a contributory cause of stillbirths and neonatal deaths, but there has been little opportunity to examine the fatality associated with such events. In so far as the department's records can be extended to cover the whole city population, it will be possible to compute fatality rates for most of the occurrences believed to be associated with increased infant mortality. Preliminary rates of this type have been given here or elsewhere for certain maternal diseases and complications of pregnancy, Rhesus serum incompatibility, and duration of labour.

(iv) Local variations within the city with respect to mortality and morbidity in relation to the use made of public health facilities can be studied intensively, thus assisting in the formulation of programmes for future development.

(v) The punch-card file can provide the basic data required for any *ad hoc* investigation, whether initiated at a national or at a local level, thus reducing considerably the work

involved. It is also easy to draw a random sample of any type required for an investigation of limited scope.

(vi) When detailed breakdowns are needed or comparatively rare conditions are being studied, numbers for a single year are too small even in a city with over a million inhabitants. Routine collection of data year by year will make it possible eventually to investigate any question on the basis of adequate numbers since the data are always available for further study.

(vii) Since all aspects of mortality and morbidity can be classified by age and parity of mother, it is possible to examine trends from year to year free from the effects of changing age and parity. This is particularly important at the present time when the proportion of first births is high and the numbers of births may rise or fall rapidly with a consequent unstable maternal age and sex composition.

3. Documents and Sources

What follows, though tentative, may be of interest to workers in Public Health Departments as illustrative of types of information which can be salvaged with comparatively little effort by appropriate design of the *Health Visitor's Record Card*, without imposing on the health visitor the burden of recording items other than those the record as formerly designed should include. The appendix exhibits both the old card and the new one which has been introduced in order to exploit mechanical aids for statistical analysis (Figs 3 to 6).

As far as possible, the items are in *self-coded* form. Where this is not practicable, space is left for office coding of:

(*a*) occupation
(*b*) cause of death on death certificate, for which office coding already existed
(*c*) a few simple arithmetical codes.

The last-named type of departure from the self-coding principle is intended to save the health visitor's very valuable time, the extra office work involved being small.

The first statistical page of the card contains basic information concerning the baby, the mother, and the family. Certain items are completed at the office before the card is sent out, from the notification of birth, and the rest is completed by the health visitor at her first or second visit.

The second page contains:

(*a*) the antenatal record, obtained from the clinic or hospital responsible for antenatal care,
(*b*) particulars of the delivery and of the baby's condition during the first two weeks after birth.

All medical items are intended to be recorded by the doctor, nurse, or midwife directly responsible, or to be copied from the doctors' record at the antenatal clinic. In no case is a layman's statement accepted about a pathological condition. To secure completion of this second page, a copy is circulated to those concerned, and the particulars afterwards transferred to the visitor's Record Card. Though copying is to be deprecated, it is here unavoidable, since the Record Card is required by the health visitor soon after the child's birth, and to circulate it might cause delay.

The third and fourth statistical pages summarize in codifiable form the main features of the child's history up to 5 years. The difficulties of reducing an historical record to statistical form are well known. In the present case, the occurrences of a few developmental events are recorded in six-monthly periods, and the remainder of the space summarizes the child's physical state and living conditions at 1 year and at 5 years. The health visitor is the main source for all information subsequent to birth. Links with hospitals and residential institutions are under review.

The Record Card is returned to the office for coding and punching on three occasions:

(*a*) as soon as the basic information on the first page has been secured, usually from 3 weeks to 2 months after birth;
(*b*) at 1 year;
(*c*) at 5 years.

In the event of death after 4 weeks, or of removal, the relevant facts are inserted and the card returned; this renders unnecessary two forms previously in use, that for deaths between 4 weeks and 1 year, and that for the follow-up of premature births.

The card for neonatal deaths is a replica of the relevant parts of the health visitor's Record Card, together with additional particulars relating to the death. For obvious reasons, most neonatal deaths are not seen by a health visitor, and the responsibility for making returns rests, as it always has done, with the hospital, or with the doctor in attendance. Supplementary information may be sought where possible from the antenatal record or from the health visitor. A stillbirth card on similar lines is in preparation. A summary of the fields of information transferred to an 80-column punch card will be found in the Appendix.

One of the main statistical problems met with in this type of work is administrative. To obtain information at first-hand, data from a variety of sources has to be assembled in one place, and this requires the co-operation of a number of busy people. All those concerned are already overburdened with important duties, and every effort must be made to economize their time and effort. The documents themselves have little claim to originality, and follow in the main existing precedents. Those reproduced in Appendix A are 1950 versions slightly modified from those of 1949. As the system develops, it should become possible to clarify definitions and to draft cards more precisely suited to public health requirements.

4. Completeness and Accuracy of Records

A punch card is made out for:

(*a*) every birth occurring in the city,
(*b*) births to Birmingham residents occurring outside the city,
(*c*) immigrant children under 5 years old as the department learns of them.

Little except the place of birth is known of births to non-residents, and the main tabulating scheme is concerned only with births to residents. In 1949 there were 20,054 births to resident mothers. Information is complete or very nearly so in

respect of residence, plurality, sex, ward, and centre, and whether the birth was domiciliary or institutional. Age of mother was known for 99·3 per cent. of these births, and parity for 99·1 per cent. The small proportion of unknowns seemed to justify their allocation in proportion to the known age and parity cells.

The greater part of the detailed tabulation and analysis relates to a slightly smaller group of 19,711 births in Birmingham and Marston Green Maternity Home to Birmingham residents. Marston Green is included because, though just outside the city limits, it is part of the public provision of maternity care for Birmingham mothers.

Information obtained through health visitors is never likely to be 100 per cent. complete. Response by the mother to a request for information is entirely voluntary and no pressure is ever exerted to obtain answers. This being so, returns for socio-economic agencies (employment of mother during pregnancy, housing, and paternal occupation) of 97 per cent. to 98 per cent. are about the maximum obtainable. The unknown groups are undoubtedly heavily biased in favour of the more prosperous families, but, with such small percentages of unknowns, the error involved is not likely to be serious. Returns from hospitals also depend on voluntary co-operation; this has been forthcoming to a gratifying extent, but may be expected to increase as the systematization of hospital records renders the process of collation less laborious.

The coverage in respect of two most important items, congenital malformations, and birth injuries and diseases in the first two weeks of life, was disappointing. Incompleteness was largely due to observers leaving a blank when there was nothing to report, and such records had perforce to be coded as unknown, but this misunderstanding is gradually being overcome. As in most medical documentation, some taxonomic difficulties were encountered. These problems should themselves prove instructive and the preliminary returns suggest a valuable and comparatively novel field; much is known about congenital malformations, and about early disease and injury leading to death or serious disability, but the incidence of minor defects and pathological conditions is far less familiar.

Complete and accurate returns in respect of the period of gestation are impossible, particularly in the absence of an early pregnancy diagnosis test. In order that the returns may have some meaning, duration is only coded when a definite date for the first day of the last menstrual period has been recorded before the birth of the baby.

Tabulation and analysis has so far dealt only with events up to and immediately after birth. Systematization of the child's later history, though no new information has been sought, is likely to prove more difficult. It may be some time before the material becomes suitable for statistical analysis, but it still has value in providing continuous and compact histories of individual children.

The scope of some of the first year's results is summarized in Table I (overleaf). Items for which the number of unknowns is less than 0·1 per cent. are given as 100 per cent. complete.

TABLE I

DEGREE OF COMPLETENESS OF DATA

Type of Data	Percentage Complete*
Residence	100
Ward	100
Centre	100
Domiciliary or institutional delivery	100
Plurality	100
Survival	100
Sex	99·5
Age of mother	99·3
Parity	99·1
Birth weight	99·7
Paternal occupation	98·6
Housing conditions	98
Employment of mother	97
Amount of antenatal care	89
Antenatal record	83
Type of delivery	82–83
Duration of labour	79
Period of gestation	73
Congenital malformations	81
Neonatal diseases and birth injuries	76

* The first nine items are related to a population of 20,054 live births, the remainder to a population of 19,711 live births.

5. SOME RESULTS OF THE FIRST YEAR'S WORK

Since the first year's working of a new record system has been partly experimental, sorting and tabulating was designed to explore a variety of fields to test the validity and usefulness of the data and to ascertain what types of investigation merit more intensive examination. To illustrate the way in which the objectives outlined in Section 2 have been met a selection from the tabular material is presented below with brief comments, and some indication of tables available for the study of annual trends; other tables have appeared in the Annual Report of the Medical Officer of Health for the City of Birmingham.

Since at the present time the main task is to improve the completeness and accuracy of the returns, no tests of statistical significance have been applied to the results. Detailed breakdowns for a single year, particularly at the present low level of neonatal mortality, very soon result in numbers too small to have any significance. As already stated, the chief value of such a scheme is that it provides for the accumulation of data routinely collected over a period of years.

Discussion of the significance of the results obtained and comparisons with previous published work have been deferred until more detailed and comprehensive studies, based on a further year's material, can be presented. These aspects of neonatal mortality will need further elaboration before practical conclusions can be safely drawn.

Four categories of information about the baby are so far available for study: neonatal mortality, birth weight, congenital malformations, and birth injuries and diseases in the first two weeks of life. Mortality and morbidity after the first month will become available for analysis at a later date. Associated with the foregoing is information which may be classified broadly under four headings:

(1) Demographic, i.e. age of mother, parity, and plurality;
(2) Socio-economic;
(3) Administrative, including information about the work of the department;
(4) Medical.

All the facts have medical aspects, but the fourth heading covers those tables which are chiefly of interest in providing material for the fatality rates described above. Needless to say, all the data are inter-related and the scheme merely indicates the fields from which the following examples have been selected.

(1) AGE OF MOTHER, PARITY, AND PLURALITY.—Parity can be treated by recording either the number of previous live births, or the number of previous live and still-births. The former is wanted for demographic purposes; the latter is more instructive for analysis of mortality and morbidity. Age of mother and live-birth parity have been tabulated for all resident births and will appear in the City Abstract. Sex by age of mother is also available. 39 per cent. of all resident births were first births. The sex ratio was 106·8 males to 100 females. In the tables of this report the parity referred to is total parity, i.e. the number of previous live and stillbirths.

Before presenting aspects of neonatal mortality, it must be noted that the mortality rates referred to are survivorship rates, i.e. they cover all neonatal deaths occurring among those born in 1949, as distinct from customary rates which relate deaths to births occurring in the same calendar year. Up to 4 weeks, migration is negligible and survivorship rates give a more accurate account in a period of falling birth and death rates, though over a period of years the difference in respect of neonatal mortality can only be small. The neonatal mortality rate for Birmingham births in 1949 obtained in this way was 17·3 per 1,000 live births.

Birmingham births were tabulated simultaneously by age of mother, total parity, and plurality, together with neonatal mortality. Tables by age and parity separately have appeared in the Annual Report. Most subsequent tables were likewise tabulated by age and parity. This enables two things to be done: changes in mortality can be presented in subsequent years with the effect of age and parity removed, and in the current year, mortality rates by socio-economic and other agencies have been standardized for differences in age and parity.

(2) SOCIO-ECONOMIC AGENCIES AFFECTING NEONATAL MORTALITY

(i) *Housing Conditions.*—Health visitors were asked to ascertain for every birth the number of persons in the household and the number of rooms occupied by the household. The new baby is included in the household and detailed instructions as to the enumeration of persons and households were issued. Since a trial run disclosed a very high proportion of babies born to households with two or more persons per room, a check survey was carried out in the field on a very small randomly selected sample of such households. The check revealed that difficulties of enumeration were great, since most of the cases were those of two or more households or families sharing a dwelling, rather than one family too big for its house. There was some tendency to describe the living conditions of the baby's immediate family rather than that of the often complex household of which the family might be a part. The effect of so doing was to exaggerate slightly the number of overcrowded cases, but it does not seem likely that errors of this kind greatly distort the picture. The figures are certainly more realistic than those

commonly presented for overcrowding in which a baby under 1 year is customarily omitted, a grotesque procedure considering the numerous situations which arise when a baby is born to a married couple living in one room. In so far as a comparison with overcrowding statistics for the city compiled on the customary basis at an earlier date is possible, there is a suggestion that those families with new babies are especially hard hit by the current housing shortage. This is what one would expect, since they are on the whole younger and less likely to be established in a pre-war house. Babies that died in hospital gave rise to some ambiguity. Usually such babies were omitted from the count of persons and reasonably so, but this led to somewhat fallacious mortality rates. In the table which follows, the dead baby is included in the household. The effect on total proportions in the various housing groups shown in Table II is negligible. Mortality rates standardized for age and parity and adjusted for deaths where housing conditions are unknown are also shown.

TABLE II

STANDARDIZED NEONATAL MORTALITY RATES, BY NUMBER OF PERSONS PER ROOM

Housing Group	Percentage of all Live Births	Standardized Neonatal Mortality Rate
Less than one person per room	23·5	15·8
One and less than 1·5 persons per room	33·0	16·0
1·5 and less than two persons per room	20·1	17·2
Two or more persons per room	23·4	18·3

The mothers living in the most overcrowded conditions fall into two groups: young mothers with a first or second child, and mothers of 35 or over with three or more previous children. The first group represents the young families unable to get a house and obliged to share or live in rooms, and the second group includes families too large for their accommodation. The number of deaths in a single year is too small to permit of any significant breakdowns by cause of death, but birth-injuries are more frequent in the most overcrowded group, and congenital malformations in the best-housed group.

Seeing that most neonatal deaths occur within a few days after birth and are largely determined pre-natally or at the time of birth, one would not expect the connexion with housing conditions to show more than the relatively slight gradient of Table II. The effect on deaths after 4 weeks is likely to be more direct. Analysis of later deaths on the lines of Table II is not yet available, but a comparison can be made between the proportion of births in the most overcrowded group by Welfare Centre areas, and the average infant mortality for the past three years in the same area (Figs 1 and 2). The product-moment correlation co-efficient (0·79) is almost certainly significant in spite of the small number of areas (31). The most overcrowded areas form a solid block in and around the " Central Areas " (scheduled for re-development). Comparison of the three worst areas (i.e. those with the highest proportions of households with two or more persons per room)

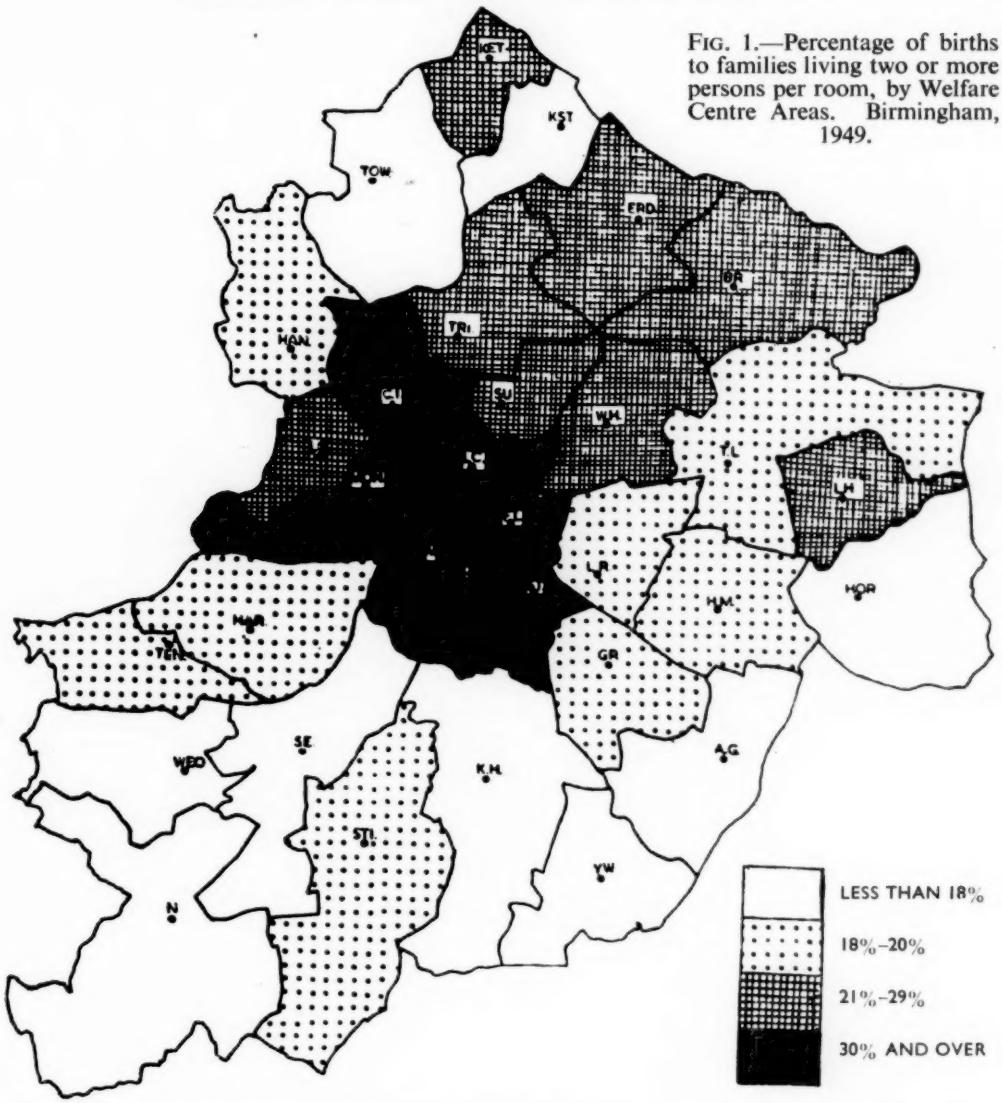


FIG. 1.—Percentage of births to families living two or more persons per room, by Welfare Centre Areas. Birmingham, 1949.

with the three best areas, shows that average infant mortality has been 67 per cent. higher in the former than in the latter. As many previous studies have shown, the relation of overcrowding to infant mortality is not a simple one. The overcrowding shown in the centre of the city is linked with comparatively low wages, derelict buildings, and a whole interlinked complex of social conditions. All that the foregoing maps and figures can do is to pin-point an area of the city where, in spite of all recent social advances, there is a section of the population living under conditions detrimental to the welfare of their children. As both maps are descriptions of social areas, it seems legitimate to compare the deaths for the past three years with the housing conditions of new babies.

(ii) *Employment of Women during Pregnancy.*—Analysis by age and parity is

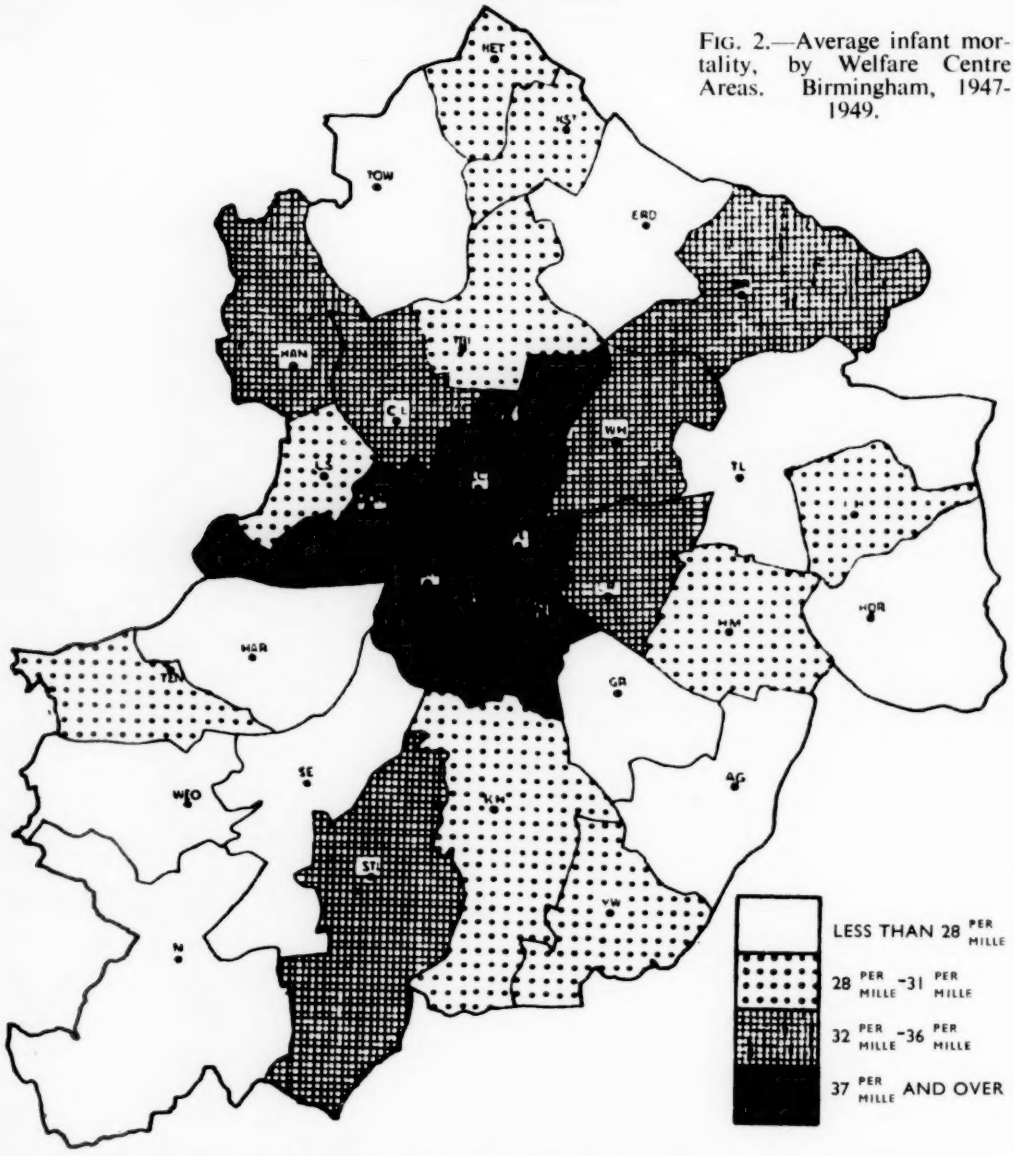


FIG. 2.—Average infant mortality, by Welfare Centre Areas. Birmingham, 1947-1949.

particularly necessary in studying the effect of employment of women in pregnancy, since, as Table III shows, the proportion working is very much greater for primiparae. In what follows, the unknown cases have been included with working mothers in order to obtain a clear-cut group of mothers known not to have been gainfully employed. The standardized neonatal mortality rate for working mothers is 21·8 as compared with 16·9 for non-working mothers. On further analysis, however, it appears that mothers gainfully employed in their first pregnancy experience lower neonatal mortality rates than those not so employed, suggesting that the adverse effects of gainful employment are associated with poverty inducing mothers of several children to go out to work.

That the number of unknown deaths does not seriously distort the picture is indicated by the fact that the proportion of immature babies ($5\frac{1}{2}$ lb. or less) follows the same pattern as that of neonatal deaths. So also do the proportions of mothers with some antenatal disease or complication. Neonatal mortality rates among mothers with no antenatal disease or complication are again lower for working mothers in first pregnancies and higher for other parities, but the difference is much less than when all mothers are taken together.

TABLE III

GAINFUL EMPLOYMENT OF MOTHERS BY PARITY*

Parity	Percentage of Mothers in Gainful Employment
Primiparae	61·3
2nd parae	19·9
3rd parae	15·3
4th parae	13·7
5th parae	16·1
6th parae and over	12·3
All parities	33·6

* Excludes 584 cases (3 per cent.) for which particulars were not available.

(3) ADMINISTRATIVE ASPECTS OF NEONATAL MORTALITY.—The main features of public health work which the present material can illuminate are antenatal care, hospitalization, and the care of immature infants. The last has already been the subject of intensive study and a detailed study of the first two would be mainly of local interest. For illustrative purposes a brief account of neonatal mortality in relation to the amount of antenatal care is presented.

Neonatal mortality rates standardized by age and parity and adjusted for unknown deaths are shown in Table IV. It has to be remembered that the amount of antenatal care was unknown for 11 per cent. of all births. Clinic patients comprise those who have attended a Corporation Clinic at least once, but the number of attendances recorded may include visits to hospitals, doctors, etc.

TABLE IV

STANDARDIZED NEONATAL MORTALITY RATES BY AMOUNT OF ANTENATAL CARE

No. of Attendances or Visits	Clinic Patients		Non-Clinic Patients	
	Percentage of all Live Births*	Standardized Neonatal Mortality Rate	Percentage of all Live Births*	Standardized Neonatal Mortality Rate
9 or more	28·0	12·9	20·5	16·1
6–8	17·7	11·8	14·4	14·8
3–5	9·1	26·9	5·9	22·8
1 or 2	2·4	37·6	1·5	54·5
No antenatal care	0·5 per cent. of all known births		99·8 standardized neonatal mortality rate	

* Excluding cases with amount of antenatal care unknown.

Deaths in the group with no antenatal care are almost entirely illegitimate births (6 out of 8) and are thus self-explanatory. The exclusion of illegitimate births and deaths would not affect the differences between the four groups above with the larger number of attendances on the one hand and the four with the lowest on the other. Again, one might surmise that deaths associated with a short period of gestation might swell the numbers in the groups with fewer attendances. This circumstance, however, could hardly affect the very high mortality rates for mothers with only one or two attendances. The amount of antenatal care is greatest for first and second children of mothers between 30 and 40. The slightly lower percentages for younger mothers may reflect higher proportions illegitimate. There is a definite falling off after the second child.

It is not suggested that there is a simple causal relationship between the number of antenatal attendances and neonatal mortality. The display of necessary initiative on the part of the mother is undoubtedly associated with social and personal characteristics contributing to the welfare of the family. In future years the accumulation of larger numbers will permit more detailed breakdowns and may throw light on the circumstances in which pregnant women fail to make use of the services available to them.

(4) Medical Aspects of Neonatal Mortality

(i) *Antenatal Record.*—When records cover a greater part of the population, the relation between the mother's health in pregnancy and the condition of the baby may prove a fruitful field of research. The antenatal record was available for 83 per cent. of all live births. A table has already appeared showing the incidence of certain diseases and complications of pregnancy and the corresponding neonatal mortality rates. In 19·9 per cent. of births with known records, some disease or complication occurred, and the neonatal mortality rate was more than four times as high for these births as for those preceded by an uncomplicated pregnancy. Of separately coded complications, the most frequent was toxaemia (1,085).

The medical record can now be related to the amount of antenatal care. Cases of Rhesus-negative mothers with agglutinins present are not included in this section.

There is a small but significantly higher proportion of women with antenatal disease or complication among those with nine or more attendances compared with the rest with known antenatal care. This is true of each complication severally and for both primiparae and multiparae, and the difference probably accounts for the slightly higher mortality rates for mothers with nine or more antenatal attendances or visits compared with those having six to eight attendances.

However, as Table V (opposite) shows, the neonatal mortality rates are higher among those with fewer attendances for women with some complication and for those with none. The excess deaths are especially frequent among multiparae with some complication and inadequate antenatal care. Table V is based on 14,922 live births. The excess mortality associated with inadequate antenatal care is chiefly seen among multiparae with toxaemia.

(ii) *Duration of Labour.*—No exact determination of the moment at which labour begins is possible, yet it seems that with sufficient numbers of observations, the data grouped within quite wide time limits might be of significance. In particular, prolonged labour is frequently regarded as a contributory cause of neonatal mortality. To avoid the fallacy of arguing backwards from a death to an arbitrarily selected previous event, it seemed worth while examining the mortality associated with different durations of labour.

Hours of labour are recorded for 77 per cent. of all first births, and for 81 per cent. of all later births. They were also known for 81 per cent. of the deaths. Values recorded oscillate in a somewhat incomprehensible manner between odd and even numbers. So the data were tabulated by 2-hour duration groups up to 29 hours, and by 10-hour duration groups thereafter. The first group, which includes cases with 0 hours labour, is of somewhat dubious validity and so is the last group of 90 hours or more. The former contains at least one Caesarean, and the latter one case said to have been of 129 hours. The very short durations include deliveries which occurred before the arrival of doctor or midwife, where the duration is largely guesswork.

TABLE V

ANTENATAL DISEASES AND COMPLICATIONS
NEONATAL MORTALITY RATES, BY AMOUNT OF ANTENATAL CARE

Antenatal Health of Mother	Antenatal Care	
	Nine or More Attendances or Visits	Less than Nine Attendances or Visits
	Neonatal Mortality Rate	Neonatal Mortality Rate
Toxaemia		
Primiparae	31·1	32·6
Multiparae	8·5	41·5
All Antenatal Diseases or Complications		
Primiparae	31·1	37·0
Multiparae	27·5	58·6
No Antenatal Disease or Complication		
Primiparae	9·3	15·3
Multiparae	8·2	8·8

The distributions for primiparae and multiparae are naturally very different. The former have a peak at 10 hours, the latter at 5 hours. Further, a much larger proportion of multiparae have durations at or near the peak value, so that the proportion with very long durations is considerably less. Both distributions are markedly skew. Table VI (overleaf) shows the percentage incidence.

Owing to the small numbers, death-rates by duration are very unstable, but when the 2-hour duration groups are smoothed by 3-period moving averages, a fairly steady trend is apparent which is very similar for both primiparae and multiparae. Both agree in showing high death rates for very short durations falling to a

TABLE VI

DURATION OF LABOUR, PERCENTAGE INCIDENCE

Duration of Labour (hours)	Percentage of all Live Births*	
	Primiparae	Multiparae
Less than 2	·5	3·2
2–3 ..	3·3	13·0
4–5 ..	6·8	17·2
6–7 ..	9·6	15·2
8–9 ..	10·1	12·6
10–11 ..	10·7	9·4
12–13 ..	9·4	7·3
14–15 ..	8·1	5·5
16–17 ..	6·1	3·9
18–19 ..	6·2	3·1
20–21 ..	4·7	2·3
22–23 ..	4·3	1·5
24–25 ..	3·4	1·3
26–27 ..	2·5	0·9
28–29 ..	2·3	0·6
30–39 ..	1·0	0·3
40–49 ..	0·6	0·1
50–59 ..	0·3	0·1
60–69 .. †	0·2	0·1
70–79 ..	0·1	—
80–89 ..	0·1	—
90 and over	0·1	—

* Omitting births with duration of labour unknown.

† One-fifth of incidence for all durations over 10-hour period.

minimum at about 8 hours. Thereafter, the death rates of primiparae rise gradually while those of multiparae remain about the same. Both again agree in showing a further conspicuous rise for durations of 23 hours and over. As the trends are so similar, all parities are combined in Table VII.

A breakdown by cause of death involves still smaller numbers and can only be suggestive. The death rate from prematurity alone is high for very short durations. Deaths attributed to injury at birth increase rapidly from 23 hours onwards. So also do deaths attributed to congenital malformations.

It is evident that when the optimum period is passed the longer the labour the greater the risk to the baby. The results obtained suggest that durations of more than 22 hours or less than 3 hours might be regarded as contributing significantly to a greater risk of neonatal death.

6. CONDITION OF BABY

(i) *Congenital Malformations.*—As stated above, the number of incomplete returns in respect of the baby's condition at birth and during the first two weeks detracts considerably from the value of the results obtained. The 1949 figures in this section are therefore presented without analysis as an indication of the kind of material which

TABLE VII

NEONATAL MORTALITY RATES BY DURATION OF LABOUR (SIX-HOURLY MOVING AVERAGES, ALL PARITIES)

Central Duration (hours)	Neonatal Mortality Rate
2½	21·5
4½	16·3
6½	14·4
8½	12·5
10½	13·8
12½	15·7
14½	16·6
16½	18·2
18½	16·8
20½	18·5
22½	20·5
24½	24·0
26½	29·3
30 and over	25·0

will become available for study as greater completeness and accuracy are achieved. Table VIII shows the incidence of congenital malformations as far as they are known.

The data of Table VIII should prove valuable in future years since they show the incidence of minor malformations and defects over a large population of births. For example, eleven cases of polydactyly were recorded, most of which would probably escape notice for statistical purposes at a later age. Some of the cases of spina bifida and mongolism may not have been confirmed by a specialist diagnosis, but the follow-up at 12 months will enable such records to be confirmed or otherwise. In accord with previous work, more than half the cases of mongolism were born to mothers aged 40 years and over.

(ii) *Birth Weight.*—In contradistinction to the material of the previous section, birth weight is known for virtually the entire population of births. The conditions under which weighing is done, particularly when midwives are single-handed, are not such as to permit of great accuracy. On account of the lumping together at quarter and half pounds, weights were grouped in half-pound intervals and the numbers in each class tabulated by age of mother and parity. In addition to the special problems of the infant weighing 5½ lb. or less, it seemed that a comparison of babies' weights from year to year might be of interest. To this end,

TABLE VIII

INCIDENCE OF CONGENITAL MALFORMATIONS

Type of Malformation	Live Births		
	Occurring singly	Combined malformations added	Percentage of all births
Spina bifida and/or meningocele	18	22	
Hydrocephaly	9	13	
Anencephaly	1	1	
Other congenital malformations of central nervous system	9	9	
Talipes	64	68	
Cleft palate and/or hare lip	39	41	
Mongolism	18	18	
Other malformations*	182	184	
More than one malformation	17	9†	
Total malformations	357		1·8
No malformation	15,671		79·5
Unknown	3,683		18·7

* "Other malformations" include:

Congenital malformation of circulatory system	17	184
,, ,, ,, digestive system	15	
,, ,, ,, genito-urinary system	14	
,, ,, ,, bone and joint	25	
Abdominal hernia	8	
Phimosis	3	
Other and unspecified	102	

Percentage of congenital malformations among known records = 2·22

† Defects unspecified.

average birth weights for condensed age and parity classes, distinguishing between single and multiple births, have been computed. Similar tables in subsequent years will enable any changes in average birth weight to be noted, free from the effect of changing age, parity, or proportion of multiple births. Average weights were obtained by regarding all weights in a half-pound class as concentrated at the mid-point of the class. Average weights obtained by fitting a curve to the crude data differed only negligibly from those obtained in this way, so that the considerable extra arithmetic involved in the more refined process did not seem to be necessary.

7. Summary

(1) A description is given of the record system introduced into the Maternity and Child Welfare Department of the City of Birmingham. The health visitors' Record Card for all live births, with parallel cards for neonatal deaths and eventually for stillbirths, has been re-designed so as to provide a continuous history from the antenatal period up to the age of 5 years. The principal occurrences are recorded in such a way that the information can be readily transferred to punch cards.

(2) While the first complete year must be regarded as still partly experimental, sufficient has been accomplished to indicate the value of the material in subsequent years, and some of the results are presented as an indication of the scope of the material.

(3) Neonatal mortality rates by age of mother, parity, and plurality have been computed. It will thus be possible to examine trends in mortality free from the influence of extraneous factors.

(4) Standardized neonatal mortality rates are presented for certain socio-economic agencies. Higher mortality was found to be associated with overcrowding and with the gainful employment of mothers who already have at least one child.

(5) Inadequate antenatal care was found to be associated with considerably higher standardized neonatal mortality rates. This was true both for primiparae and multiparae and for mothers with and without an uncomplicated pregnancy.

(6) Fatality rates associated with antenatal complications and with varying durations of labour are presented.

(7) Table VIII shows, as far as was ascertainable, the incidence of congenital malformations of all types recognizable at birth. Average birth weights have been computed for age and parity classes, distinguishing single and multiple births, with a view to annual comparisons.

APPENDIX

Summary of Fields of Information

The following items are transferred to punch cards from the Health Visitor's Record reproduced in Figs 4-6 (overleaf). The card formerly in use is shown in Fig. 3 (opposite) for comparison.

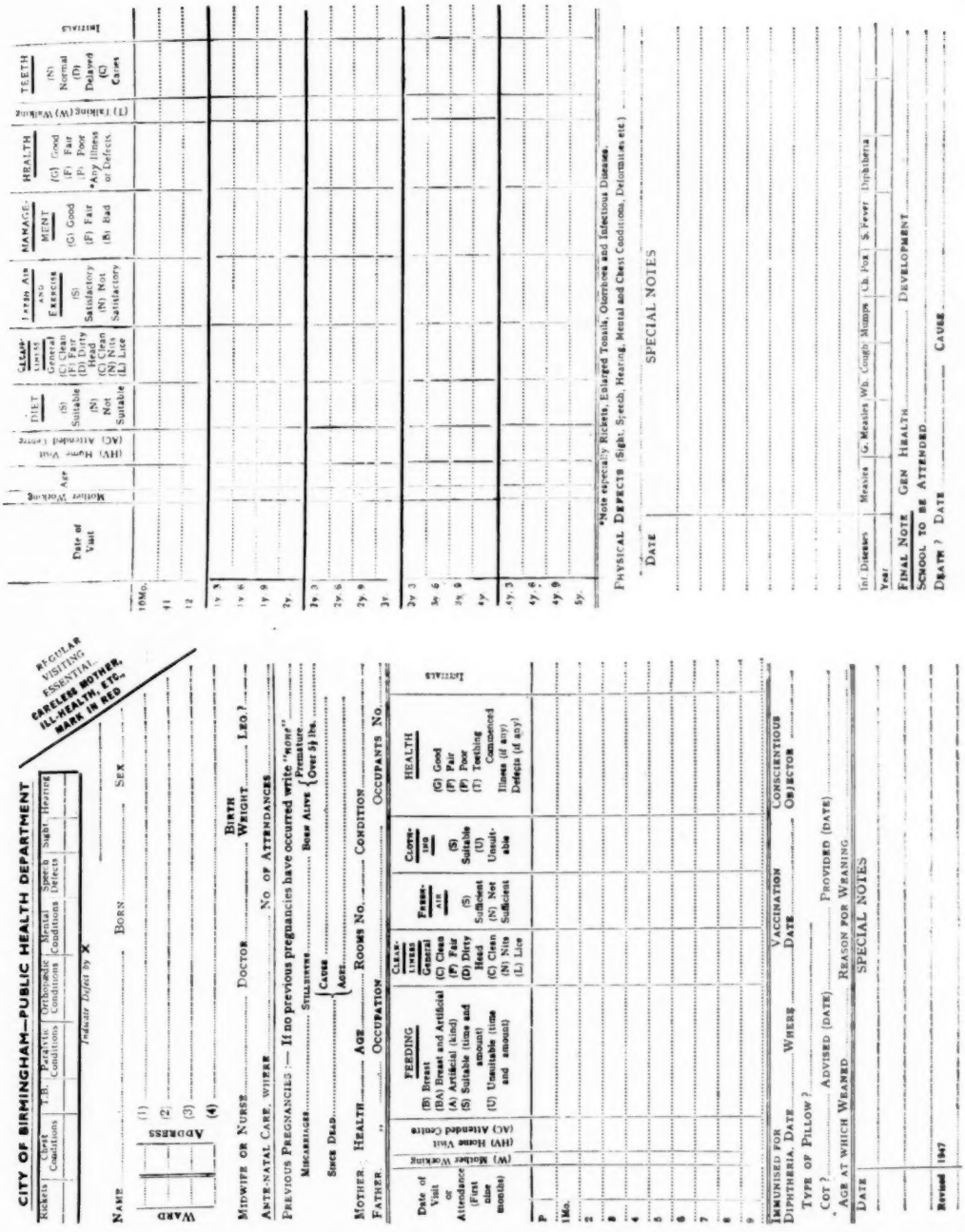


FIG. 3.—Health Visitor's Record, 1948. Maternity and Child Welfare Department, City of Birmingham.

CHILD HISTORY
0–12 months

FEEDING

Breast feeding ended during 55 — X | 0. Not started | Ended in Month: 1 2 3 4 5 6 7 8 9+

Artificial feeding started during ... ... 56 — X | 0. Not applicable | Started in Month: 1 2 3 4 5 6 7 8 9+

Reason for not starting or failing to complete breast feeding

57 — X | 0. Not applicable | 1. Insufficient milk | 2. Condition * of mother | 3. Mother dead | 4. Condition * of baby | 5. Baby dead | 6. Other *

*Specify

MEDICAL SUPERVISION OF BABY in 1st year

58 ... ... — X | 0. None | 1. Centre only | 2. Centre & Doctor | 3. Centre & Hospital | 4. Centre, Dr. & Hospital | 5. Doctor only | 6. Hosp. or Nurs. Home | 7. Other

LIVING WITH—at 1 year (or death)—

59 ... ... — X | 0. Both Parents | 1. Mother only | 2. Father only | 3. Grand-parents | 4. Other Relatives | 5. Adopted | 6. Foster Parents | 7. Residential Institution | 8. Other

MOTHER STARTED WORKING IN—

60 — X | 0. Not applicable | 1. Mother not working in 1st year | Started work * when baby was age: 2. 0-3 months | 3. 3-6 months | 4. 6-9 months | 5. 9-12 months

*If part-time, state here ...

ROOMS occupied by household at 1 year (or death) ☐ PERSONS in household at 1 year (or death) ☐

OFFICE P/R 61

CLINIC RECORD

At 6 months. Weight, lbs. ☐☐ ozs. ☐☐ Height, ins ☐☐ — Weight 62 63

Exact age at weighing, Months ... days ...

At 1 year. Weight, lbs. ☐☐ ozs. ☐☐ Height, ins. ☐☐ — Height 64 65

Exact age at weighing, Yrs. ... Mths. ... days

If death or removal occurs between 4 weeks and 1 year, complete both sides as far as possible and return to office.

If died of infection state SOURCE 71 (a) — X | 0. No. Inf. | 1. Home | 2. Hospital | 3. Other — Age at death or removal 66 67 (a)

DATE of DEATH (or removal) ... PLACE of DEATH ...

CAUSE of DEATH (Death Certificate) ... — Cause 68-70

POST MORTEM 72 (a) — 0. YES | 1. NO

OFFICE

77 (a) — X | 0. Foet. Abn. | 1. Resp. Inf. | 2. Dig. Inf. | 3 Oth. Inf. | 4 Accident | 5. T.B. | 6. Other

PART C. ANTENATAL RECORD

ANTENATAL DISEASES & COMPLICATIONS

38 — X | 0. None | 1. Toxaemia | 2. W.R.+ | 3. Rubella† | 4. Non toxic A.P.H. | 5. Pyelitis | 6. Anaemia | 7. Varicose Veins | 8. Other * | 9. Combination of foregoing. Sp. Nos. ...

†Date of Onset ... *Specify ...

MOTHER—RHESUS TEST 39 — X | 1. Pos. | 2. Neg: Agglutinins absent | 3. Neg: Agglutinins present

FIRST DAY OF LAST MENSES (if known) ...

PART D. DOCTOR OR MIDWIFE AT DELIVERY

OFFICE Gestation 40 41 ☐☐ Hours Labour 42 43 ☐☐

LABOUR—Onset date ... Time ... a.m. p.m.

Birth date ... Time ... a.m. p.m.

TYPE OF LABOUR

44 — X | 0. Spont. onset Spont. deliv. | 1. Spont. onset Instr. deliv. | 2. Med. Ind. Sp. delivery | 3. Med. Ind. Instr. deliv. | 4. Surg. Ind. Sp. delivery | 5. Surg. Ind. Instr. deliv. | 6. Med. & Surg. Ind. Sp. Delivery | 7. Med. & Surg. Ind. Instr. Delivery | 8 Caesarean | 9 Other *

*Specify ...

FIXATION OF PRESENTING PART AFTER ONSET OF LABOUR

45 — X Not known | 1. Normal Vertex | 2. Occipito-Posterior | 3. Brow | 4. Face | 5. Breech | 6. Other presentation due to transverse lie | 7. Other *

*Specify ...

MATERNAL COMPLICATIONS OF LABOUR & PUERPERIUM Specify ...

ATTENDANT AT BIRTH

46 — X | 0. Midwife only | 1. Midwife & Med. Aid | Domiciliary Midwifery: Mat. Service G.P. booked 2. Absent | 3. Present | 4. Pr. Dr. | 5. Ambulance Nurse | 6. B.B.A. | Institutional Midwifery: 7. Hosp. | 8. Pte. Nursing Home

47 BABY RHESUS TEST — X | 2. Pos. | 3. Neg. — BIRTH LENGTH ins. ☐☐ 48 49

CONGENITAL MALFORMATIONS OBSERVED IN THE FIRST TWO WEEKS

50 — X | 0. None | 1. Spinabifida &/or Meningocele | 2. Hydro-cephaly | 3. Anencephaly | 4. Talipes | 5. Cleft Palate &/or Hare Lip | 6. Mongol | 7. Other * | 8. Combination of foregoing. Sp. Nos. ...

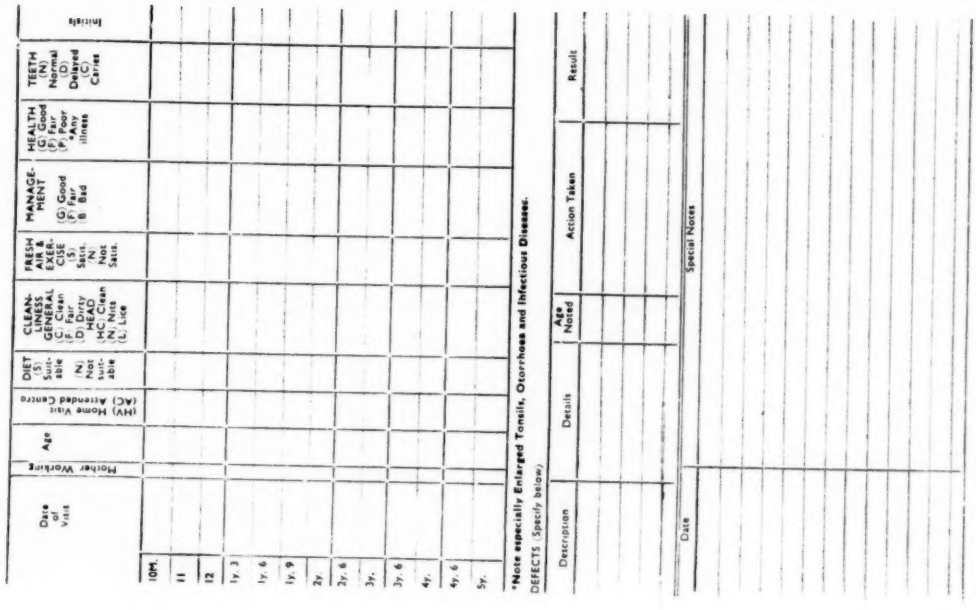
*Specify ...

BIRTH INJURIES & DISEASES OF THE NEWBORN

51 — X | 0. None | 1. W.R.+ | 2. Ophthalmia | 3. Oth. infection * | 4. Icterus simplex | 5. Haemolytic disease | 6. Birth injury * | 7. Other * | 8. Combination of above (Sp. Nos.) ...

*Specify ...

FIG. 4.—Health Visitor's Record, 1950 (page 1, front and back). Maternity and Child Welfare Department, City of Birmingham.



HEALTH VISITOR'S RECORD

Name ——— Born ———

Visiting Area ——— Clinic attended ———

Change of Address

2. ———
3. ———
4. ———

Change in Housing (2) Rooms ——— Occupants ——— Date ———

(3) " " "

(4) " " "

Mother's health (Specify any illness) ——— Father's health ——— Specify any illness

Regular Visits needed Mark Red X

Card needed urgently Mark Red U

Date of Visit	Mother Working	Age	(HV) Home Visit (AC) Attended Centre	DIET (S) Suitable (N) Not suitable	CLEANLINESS GENERAL (C) Clean (F) Fair (D) Dirty HC) Clean N) Nits (L) Lice	FRESH AIR & EXERCISE (S) Satis. (N) Not Satis.	MANAGEMENT (G) Good (F) Fair (B) Bad	HEALTH (G) Good (F) Fair (P) Poor *Any illness	TEETH (N) Normal (D) Delayed (C) Caries	Initials
10M.										
11										
12										
1y. 3										
1y. 6										
1y. 9										
2y										
2y. 6										
3y.										
3y. 6										
4y.										
4y. 6										
5y.										

*Note especially Enlarged Tonsils, Otorrhoea and Infectious Diseases.

DEFECTS (Specify below)

Description	Details	Age Noted	Action Taken	Result

Special Notes

Date

Date of Visit or Attendance (First nine months)	(W) Mother Working	(HV) Home Visit (AC) Attended Centre	FEEDING (Fed (B) Breast & (BA) Breast & Artificial (A) Artificial (S) Suitable (time & amt.) (U) Unsuitable (time & amt.)	CLEAN LINESS GENERAL (C) Clean (F) Fair (D) Dirty HC) Clean Nits (N) Lice (L)	FRESH AIR (S) Sufficient (N) Not sufficient	CLOTHING (S) Suitable (U) Unsuitable	HEALTH (G) Good (F) Fair (P) Poor (T) Teething commenced illness (state day	Initials
1								
1 Mo.								
2								
3								
4								
5								
6								
7								
8								
9								

Cot(?) ——— Advised (Date) ——— Provided (Date) ———

Type of pillow(?) ——— Advised ——— Provided ———

Fire guard(?) ——— Advised ——— Provided ———

Date

Special Notes

FIG. 5.—Health Visitor's Record, 1950 (page 2, front and back).

CITY OF BIRMINGHAM—PUBLIC HEALTH DEPARTMENT
LIVE BIRTH

PART A. OFFICE

Midland Personnel No.:— (1-9) | Born— Day | Month | Year | Ward (10 11) | Centre (12 13)

Name ____ M | F

Address ____

Where born ____ Name of Doctor or Midwife ____

PLURALITY 14 (this birth): X | 0. Single birth | 1. Twin 2L. | 2. Twin 1L.1SB. | 3. Triplet 3L. | 4. Triplet 2L.1SB. | 5. Triplet 1L.2SB. | 6. Quad. | 7. Quin.

BIRTH WEIGHT lbs. (15 16) ozs. (17 18)

PART B. HEALTH VISITOR

RESIDENCE 19: 0. Born & Res. B'ham. | Born away. Res. B'ham. 1. M.G.M.H. 2. Other | 3. Born B'ham. Res away | 4. Immigrant

MOTHER'S AGE at birth of Child (Age last birthday) (20 21) | Maternal Midland Personnel No.: Mother Born— | Day | Month | Year

OCCUPATION—Father (or principal breadwinner)

Mother (Gainful) ____ Wks. worked while pregnant (22 23)

No. ROOMS occupied by household ____ No. PERSONS in household ____

PREVIOUS PREGNANCIES — Previous Livebirths

Stillbirths (28) ____ Miscarriages ____ Immature (5½ lbs. or less) (29) ____ Mature (Over 5½ lbs.) ____

Deaths of previous children: 0-4wks. (30) ____ 4wks.-1yr. ____ Over 1yr. ____

RESPONSIBILITY FOR ANTENATAL CARE

35: X | 0. None | 1. Midwife & Centre | 2. Mat. Service G.P. | 3. Private Doctor | 4. Hospital

Centre attended ____

Number of attendances or visits ____

Centre	Midwife	Mat. Service G.P.	Private Doctor	Hosp.	Pte. Nurs. Home

IMMATURE BABY ONLY (5½ lbs. or less).

Was baby transferred to hospital or Special P.B. Unit for nursing care? No | Yes

If yes, specify where ____

AGE WHEN TRANSFERRED

37: X | 0. Not applicable | 1. In 1st. 24 hrs. | 2. Over 1 day & under 1 wk | 3. 1 week | 4. 2 wks. | 5. 3 wks.

OFFICE

Occ. (24–26) ____

P-R (27) ____

Live (31 32) ____

Total (33 34) ____

A.N. (36) ____

Pr. Visit (52) ____

Disposal (53) ____

Year (54) ____

0 Leg. | 1 Illeg. (60)

CHILD HISTORY
0-5 years

DEVELOPMENT

Speech—Single words at:—

66 (b): X | 0. No | 1. 6mths-1yr. | 2. 1-1½yrs. | 3. 1½-2yrs. | 4. 2-2½yrs. | 5. 2½-3yrs. | 6. 3-3½yrs. | 7. 3½-4yrs. | 8. 4-4½yrs. | 9. 4½-5yrs.

Two word sentences at:—

67 (b): X | 0 No | 1. 6mths-1yr. | 2. 1-1½yrs. | 3. 1½-2yrs. | 4. 2-2½yrs. | 5. 2½-3yrs. | 6. 3-3½yrs. | 7. 3½-4yrs. | 8. 4-4½yrs. | 9. 4½-5yrs.

Walked alone at:—

68 (b): X | 0. No | 1. 6mths-1yr. | 2. 1-1½yrs. | 3. 1½-2yrs. | 4. 2-2½yrs. | 5. 2½-3yrs. | 6. 3-3½yrs. | 7. 3½-4yrs. | 8. 4-4½yrs. | 9. 4½-5yrs.

Milk dentition complete at:- 71 (b): X | 0. No | 1. 2-2½yrs. | 2. 2½-3yrs. | 3. 3-3½yrs. | 4. 3½-4yrs. | 5. 4-4½yrs. | 6. 4½-5yrs.

WEIGHT & HEIGHT

At 5 yrs. Weight, lbs. ____ ozs. ____ Height, ins. ____

Exact age at weighing, Yrs. ____ Mths. ____ days ____

OFFICE Weight (72, 73 (b)) ____ Height (74, 75 (b)) ____

DEFECTS AT 5 YEARS

X	0. None	1. Infestation	2. Teeth	3. Skin	4. Eyes	5. Ears	6. Nose or Throat	7. Speech	
76, 77 (b)	8. Cervical Glands	9. Heart & Circulation	10. T.B. Resp	11. T.B. Other	12. Other Chest	13. Hernia	14. Other developmental	15. Orthopaedic	
	16. Paralytic *	17. Rickets	18. Nervous System	19. Mental	20. Other *	21. Combination of above. Sp. Nos.			

*Specify ____

IMMUNIZATION (Diphtheria)

First Dose — Date ____ Place ____ VACCINATED

Final Dose — Date ____ Place ____ Date ____

Supplementary Dose — Date ____ Place ____

At 5 years 78 (b): X | 0. Not Vacc. Not. Imm. | 1. Vacc. only | 2. Imm. Only No Supplementary | 3. Imm. & Supplementary | 4. Vacc. & Imm No Supplementary | 5. Vacc. & Imm & Supplementary

INF. DISEASES 69, 70 (b) Year

Measles	G. Measles	Wh. Cough	Mumps	Ch. Pox	Sc. Fever	Diphtheria	Other inf.

LIVING WITH:—at 5 years— 79 (b): X | 0 Both Parents | 1. Mother only | 2. Father only | 3. Grand-Parents | 4. Other Relatives | 5. Adopted | 6. Foster Parents | 7. Residential Institution | 8 Other

SCHOOL TO BE ATTENDED ____

National Registration Number:— ____

Address at 5 years:— ____

Fig. 6.—Health Visitor's Record, 1950 (page 3, front and back).

(i) Midland Personnel Number. This is a 9-column personal code number originated by the Department of Medical Statistics in the University of Birmingham. It embodies date of birth and sex for which 6 columns would be required in any case. It also permits of the cards being sorted back into the filing order required by the office after a series of Hollerith tabulations. In the future it is expected to facilitate collation with hospital documents and the work of other departments.

(ii) Residence (Birmingham or out-of-city, ward, centre).

(iii) Maternal age, previous live and stillbirths, premature births, neonatal deaths, plurality.

(iv) Occupation of father and principal breadwinner, persons per room.

(v) Weeks of employment during pregnancy, antenatal care, antenatal diseases and complications. Maternal Rhesus test.

(vi) Period of gestation, attendant at birth, duration and type of labour, presentation.

(vii) Birth weight, length, congenital malformations, neonatal diseases and birth injuries, baby's Rhesus test.

(viii) Premature care.

(ix) At one year: family status (living with both parents, adopted, etc.), employment of mother, persons per room, weight, height.

(x) Developmental history: breast feeding, speech, walking, dentition.

(xi) At 5 years: family status, persons per room, weight, height, defects, infectious diseases, vaccination and immunization.

(xii) Deaths. Relevant portions as above, and age at death, cause of death, revised cause of death, *post-mortem* findings, breast feeding, source of infection, medical supervision.

REVIEWS

The Hospital in Contemporary Life. Edited by NATHANIEL W. FAXON, M.D. 1949. Harvard University, Cambridge, Mass. Pp. 288. (27*s.* 6*d.*)

This book contains contributions from eight members of the staff of the Massachusetts General Hospital and the Faculty of the Harvard Medical School, based on a series of lectures delivered in January, 1948, under the sponsorship of the Lowell Institute in Boston.

In the United States of America one in every ten persons is admitted annually to a hospital. Considered purely as a " business ", the hospitals rank as the fifth largest in the country with an investment of some four billion dollars; yet in 1940, on an average, each citizen spent only $4.63 on hospital care, compared with $10.71 for patent medicines, $24.36 for tobacco, and $62.10 for liquor. This is in a country where even a patient in the public ward may be required to pay almost the full cost of his maintenance.

Three broad fields are covered by the writers of this book: the development of the hospital from earliest times, and its gradual change from a House of Pity for the poor, sick, and dying, to its present function as a curative centre for the treatment of disease; the cost and management of hospitals by state and private charity; and the place taken by the teaching hospitals in medical education. The whole picture of the present-day status and function of the hospital is skilfully built up and critically appraised in the light of modern knowledge and social needs. To select individual contributions from such a galaxy may seem invidious, but particularly absorbing are the chapters on " The Development of the Hospital " by Dr. Edward D. Churchill; " The Care of the Patient " by Dr. Leland S. McKittrick; and " The Education of the Doctor " by Dr. Oliver Cope.

This book is addressed primarily to the layman, but it is so full of medical information and stimulating ideas that no doctor could fail to read it with interest and profit.

CATHERINE SWANSTON

United Nations Department of Social Affairs: Annual Report on Child and Youth Welfare, 1947-1948. 1949. United Nations Publications, Lake Success, New York. P. v + 308. (15*s.*)

This volume contains the full texts of the reports submitted by 26 nations on the progress made in their respective countries in the field of child and youth welfare. Part I gives detailed information concerning a wide range of activities. Of particular interest is the Russian report. Couched in a somewhat flamboyant phraseology which contrasts oddly with the stiff, official language of the other contributions, it recounts the social advances made by the Soviet state since the October revolution, and describes the havoc wrought by the invading German armies in the recent war, and the tremendous amount of repair work which has been necessary.

Part II is devoted to summaries of texts of legislation relating to child and youth welfare enacted in 1947. These are conveniently grouped by the subject of legislation, each country being noted separately.

This is an important reference book for all those concerned with the social welfare of the child and adolescent. CATHERINE SWANSTON

Researches on the Measurement of Human Performance. By N. H. MACKWORTH. 1950. Med. Res. Council. Spec. Rep. Ser. No. 268. H.M.S.O. Pp. 156, 58 figs. 4*s*.

During the recent war, Dr. Mackworth and his colleagues were set to tackle two very practical problems:

(1) What happens when men are required over long periods of time to watch or listen for hardly distinguishable signals occurring irregularly at unpredictable intervals? Vigilance of this sort was demanded of the radar-observer and the Asdic operator in the endless search for submarines.

(2) What happens when sensory, intellectual, or muscular work has to be kept up for a long time under increasingly difficult environmental conditions, as, for example, when men are submitted to high concentrations of irritant or harassing agents, or have to withstand extremes of heat or humidity?

This report gives practical answers to some of these questions raised by the conditions of modern war, but its importance far exceeds the limits of the specific problems studied. For here is the outline of psychological and physiological methods readily adaptable to the study of problems of human efficiency under a great variety of circumstance, both in war and in peace. Dr. Mackworth treads the boundary line between psychology and physiology with confidence. Students of both disciplines will long find it useful to refer back to this pioneer work. R. PASSMORE

ABSTRACTS

(This section of the JOURNAL *is devoted to selected abstracts of articles on social medicine appearing in the current literature. The section will be edited in collaboration with the two abstracting Journals,* Abstracts of World Medicine, *and* Abstracts of Surgery, Obstetrics and Gynaecology.)

Cardiovascular and Renal Findings in Long-standing Diabetes Mellitus. A Study of 221 Patients Surviving at Least 15 Years. [In English.] MARTENSSON, J. (1950). *Acta med. scand.*, **138,** 94.

The purpose of the investigation was to determine the incidence and degree of severity of cardiovascular and renal diseases in a Swedish series of long-standing diabetics. The series comprised 221 cases (111 men, 110 women) of diabetes of 15 to 34 years' duration in patients ranging from 16 to 84 years of age at re-examination. Hypertension was present in 124 cases (57 per cent. of the entire series), in 48 per cent. of the men, and in 65 per cent. of the women. Definite signs of arteriosclerosis of the coronary vessels were seen in 82 patients (43 per cent.), eleven of whom also had myocardial infarction. Only six were under 50 years of age. Gangrene, chronic ulceration, or severe arterial insufficiency of the lower extremities, was present in 42 cases (19 per cent.). In fourteen cases amputation was necessary. Nephropathy was found in 71 cases (34 per cent.) with a preponderance in the younger age groups. Of the thirty cases examined post mortem, seven presented a more or less typical picture of intercapillary glomerulosclerosis. A survey is given of the incidence of co-existent cardiovascular and renal complications in the various cases.—[*Author's summary.*]

Degenerative Changes in Young Diabetic Patients in Relationship to Level of Control. JACKSON, R. L., HARDIN, R. C., WALKER, G. L., HENDRICKS, A. B., and KELLY, H. G. (1950). *Pediatrics*, **5,** 959.

To assess the incidence and severity of degenerative changes in diabetes and their relation to the level of control and the duration of the disease, 75 juvenile subjects with severe diabetes of over 10 years' duration were studied in great detail. Each patient was subjected to a complete physical examination, chest radiography, electrocardiography including vector leads, radiography of the pelvis and limbs for evidence of calcification of peripheral vessels, a complete eye examination, a growth study, and various biochemical investigations.

In 46·6 per cent. there were retinal changes indicating various phases of diabetic retinopathy, and there was a highly significant statistical correlation between the incidence of these and the duration of the disease, as well as the degree of deficiency of control; 14·6 per cent. had cataractous changes, but no correlation like that in retinopathy could be found. In 16·0 per cent. peripheral vessels were calcified, and again there was a highly significant statistical correlation with duration and degree of control. Neither age of onset nor severity of the disease could be related statistically to presence of retinopathy, vessel calcification, or cataract. Although 4·0 per cent. had hypertension and 4·0 per cent. had albuminuria, there were no abnormal electrocardiographic findings. In cases in which control of diabetes was poor, gains in height and weight were less than expected. The incidence of acidosis and ketosis was correlated with the incidence of lens changes. There was no correlation between plasma protein levels and any of the specified variants. The serum lipid level was consistently higher in those with poor control of diabetes and, conversely, normal levels were only found in those in whom control was excellent. The authors conclude by stressing the need for a high level of control of diabetes, because such control may delay and possibly prevent serious degenerative changes. *David Morris*

Studies on Diabetes Mellitus: The Relation of Stressful Life Situations to the Concentration of Ketone Bodies in the Blood of Diabetic and Non-diabetic Humans. HINKLE, L. E., CONGER, G. B., and WOLF, S. (1950). *J. clin. Invest.*, **29,** 754.

The authors studied, in diabetic patients and normal persons, the effect of psychological stress (unpleasant and irritating memories) on the level of ketone bodies in the blood. At the same time glycaemic changes were observed. Levels were measured in the morning with the subjects fasting, and after a period of rest the subjects were treated to an hour of " stressful " mental reminiscences with subsequent blood analysis; these last were repeated after another, " stressless ", hour. The published figures show a temporary slight rise in ketonaemia in normal persons and a more exaggerated one in diabetic patients. [Not enough detail of diet and protamine-insulin dosage is given to permit a critical appreciation of the ketonaemic state to be expected in the diabetic patients.]

The authors' figures give adequate proof of their thesis, and they suggest that the brief increase in ketosis caused by stress is due to a stimulation of the pituitary-adrenal mechanism [Selye's theory again].

[A minor point of criticism is that the authors support their arguments by reference to four unpublished papers.]

R. C. Lawrence

Poliomyelitis and Immunization Against Whooping-cough and Diphtheria. BANKS, H. S., and BEALE, A. J. (1950). *Brit. med. J.*, **2**, 251.

The relation between immunizing injections and poliomyelitis is discussed with special reference to cases admitted to the Park Hospital, London, during the period 1947-49.

Of 111 patients with paralysis observed in this period, fourteen, all in children under the age of 5, had received one or more injections within the previous 2 months. In most cases the onset of paralysis occurred from 9 to 14 days after the injection. In nine cases paralysis followed injection of combined pertussis and diphtheria prophylactic, in one case pertussis prophylactic alone, and in four cases diphtheria prophylactic only. The paralysis, which affected much the same group of muscles in all cases, was not associated with any particular technique or locality. The authors conclude that during periods of high prevalence of poliomyelitis there is a definite, though small, risk that serious limb paralysis, affecting mainly muscles adjoining the site of injection, will follow inoculation with the types of pertussis and diphtheria prophylactic commonly used in Britain. They do not advance any theory to account for this remarkable phenomenon. *Jos. B. Ellison*

Inoculation and Poliomyelitis. A Statistical Investigation in England and Wales in 1949. HILL, A. B., and KNOWELDEN, J. (1950). *Brit. med. J.*, **2**, 1.

In view of the reports of Martin (1950), McCloskey (1950), and Geffen (1950), which strongly suggested a causal connexion between paralytic poliomyelitis and recent immunizing injections, the authors, at the request of the Ministry of Health, endeavoured to obtain a rapid answer to the question whether the paralytic poliomyelitis could be justly attributed to the preceding inoculation. They obtained the inoculation histories in all cases of poliomyelitis under 5 years of age from 33 different areas in which at least twenty cases had been notified in the 5 months July to November, 1949. The Medical Officer of Health of each area was asked to select for each case a control child, either (1) of the same sex and age, who was notified as suffering from measles at approximately the same date as the child with poliomyelitis, or (2) of the same sex and born at the same time as the one with poliomyelitis, the names to be drawn from the notification of births and deaths register. In this way 164 closely paired controls were obtained. The statistics thus collected revealed a clear association between recent injections and paralysis. In children inoculated within one month preceding onset the distribution of the sites of paralysis was quite abnormal. In this group paralysis in the arms was just as frequent as paralysis in the legs, and the left arm was paralysed more often than the right, whereas in children not given recent injections the two arms were equally affected and the legs were affected two to three times as often as the arms. In the recently inoculated children the limb of injection (arm or leg) was paralysed much more frequently than in children not recently inoculated. Moreover, the excess of *recently* inoculated children in the poliomyelitis group compared with the control group, and the equality in the two groups at other intervals, suggests that the former included cases which would not have been diagnosed as poliomyelitis at all if there had been no previous and recent inoculation. The data suggest, in the authors' opinion, that such children were brought by inoculation into the paralytic class.

Paralysis in the limb of recent injection followed inoculations with diphtheria alum-precipitated toxoid (A.P.T.) and with combined A.P.T. and pertussis antigens. The intervals between the last injection and the onset of symptoms of poliomyelitis lay mainly between 8 and 17 days. It is concluded that these cases had occurred in England and Wales during the poliomyelitis outbreak of 1949 more frequently than could be attributed to chance. *H. Stanley Banks*

Comparative Results of Radiological Examination of the Population as a Whole and Examination Limited to Potential Contacts in the Detection of Tuberculosis. (Résultats comparés des examens radiologiques collectifs et des examens d'entourage dirigés dans le dépistage de la tuberculose.) PRESS, P. (1950). *Schweiz. Z. Tuberk.*, **7**, 17.

This investigation is an attempt to evaluate the relative merits of routine mass radiography surveys and of systematic contact examinations at the Geneva Tuberculosis Centre within the framework of a case-finding programme. The groups subjected to mass radiography surveys comprise university students (70 per cent. attendance), school-children between the ages of 8 and 14 (95 per cent. participation), employees in various industries (attendance varying between 50 and 90 per cent.), and the staffs of non-industrial undertakings (70 to 80 per cent. participation). The analysis of 10,964 films revealed 4·7 intrathoracic abnormalities per thousand. Only 3·4 per thousand were clinically significant. With 0·6 non-tuberculous lesions per thousand the total incidence of active pulmonary tuberculosis did not exceed 2·8 per thousand of the total (thirty cases).

In contrast to this survey 504 contact cases were investigated at the Tuberculosis Centre during the same year with the result that clinically evident chest disease was discovered in 29·8 per thousand of the cases (27·8 per cent. tuberculosis, 2 per cent. non-tuberculous disease).

As far as it is permissible to compare a series of some 11,000 cases with another of 500 and to draw any inference of statistical significance, it appears that systematic investigation of contacts of known cases of pulmonary tuberculosis yields ten times as many new cases as random examination of volunteers attending mass radiography surveys. The efficiency of the latter method clearly depends on the percentage participation in the event. [Bradbury (*Lancet*, 1948, **2**, 293) showed that, in order to discover at least 50 per cent. of the tuberculous members of any group surveyed, 70 per cent. of the group must be examined.] The success of systematic contact examination, that is, a satisfactory response of "contacts" to the call for examination, depends on the co-operation of the medical profession and on the proper personal approach by the health visitor and/or the social worker. The author believes that the effectiveness of mass radiography could be improved if a higher percentage of attendance were achieved. He concludes that, "The two methods do not oppose each other, they

supplement each other". [In Britain there is a growing body of opinion that mass radiography routine surveys contribute less to a comprehensive case-finding programme than periodical mass radiography surveys of hazardous industries, together with assistance in systematic contact examinations and follow-up. More time should also be given for public sessions for persons sent by their own doctor, because of suspicious symptoms, or coming on their own account.] *E. G. W. Hoffstaedt*

Ventilatory Tests in Bronchial Asthma. Evaluation of Vital Capacity and Maximum Breathing Capacity. GAENSLER, E. A. (1950). *J. Allergy*, **21**, 232.

In bronchial asthma the maximum breathing capacity (M.B.C.) is often reduced more than the vital capacity (V.C.), and its measurement is therefore recommended in testing the effect of asthmogenic and of protective substances on the asthmatic subject. In 34 patients with asthma and 150 patients with parenchymal lesions of the lungs both M.B.C. and V.C. were measured and the results expressed as the percentage of the values predicted by calculation from age, sex, and body measurements, the ratio $\frac{\text{per cent. predicted M.B.C.}}{\text{per cent. predicted V.C.}}$ being termed the "air velocity index". In patients with less of functional pulmonary tissue this index was greater than 1, in asthmatics smaller than 1, indicating that in the former group the greater reduction is in the V.C., whereas in the latter group the M.B.C. shows the greater reduction.

[The author admits that in some asthmatics the maximum breathing test may provoke an asthmatic attack. In the experience of the abstracter this is frequently the case, although the attack may be mild and transient. This may explain the relatively small maximum breathing capacities found by the author in asthmatics. As the "asthmogenic" effect of hyperventilation varies greatly, the value of this test in asthmatics must be regarded as limited.] *H. Herxheimer*

Influence of Age, Sex, Physique, and Muscular Development on Physical Fitness. CULLUMBINE, H., BIBILE, S. W., WIKRAMANAYAKE, T. W., and WATSON, R. S. (1950). *J. appl. physiol.*, **2**, 488.

The response to moderate and severe exercise and the strength and the speed of movement have been measured for 7,000 Ceylon subjects from the age of 10 years upward. The fitness index (for 5 minutes of moderate exercise) and the endurance index (severe exercise) decreased with age. The fitness index also decreases with increasing developmental level, but the endurance index is not related to the developmental levels. These indices are based partly on the time of performance of a standard type and rate of exercise. If the work performed is taken into account then the older subjects give the better assessments.

Speed, strength, and the ability to sustain moderate effort to exhaustion all increase with age, to reach maxima in early manhood or womanhood. These aspects of dynamic fitness also increase with increasing developmental level. In all respects female subjects give poorer assessments than do males. Those with a normal or a stocky body build have, on an average, the greatest speed, the greatest strength, and the greatest ability to sustain prolonged muscular effort. Severe exercise is best performed by those with a slim body build.

Within the range presented by our group of subjects, the less the leg muscle development the greater was the fitness index and the endurance index. The greater the leg muscle development, the greater was the speed of movement. The greater the arm muscle development, the greater was the strength.—[*Authors' summary.*]

The Present State of Accelerated Growth in the Newborn and Toddlers. (Der gegenwärtige Stand der Acceleration bei Neugeborenen und Kleinkindern.) FREUND, J. (1950). *Z. Kinderheilk.*, **67**, 592.

The author reviews two previously published investigations by Wahl and Kemmerling on height and weight of young children and compares their findings with his results. The former studies were carried out in Cologne and Munich before the war, the latter between the years 1943 and 1948. Though Wahl found an average height of 51·47 cm. and an average weight of 3,404 g. for the normal infant at birth before 1939, the author's calculations showed an increase of 0·17 cm. in height and a decrease of 58 g. in weight for 1943-48. For births during the war the differences were +0·36 cm. and −39 g., in comparison with Wahl's figures, and for the post-war years the differences were −0·33 cm. and −99 g. The increase in height of babies born at term was maintained and varied between 1 and 1·5 cm.; the small decrease in height from 1945 onwards can be overlooked from the statistical point of view. In spite of exogenous factors (insufficient quantity and inferior quality of food, mental stress, lack of flats and houses due to bombing attacks) the measurements were practically the same; abortions, miscarriages, and stillbirths showed, however, an enormous increase in number. The duration of pregnancy for babies born during the war was 281 to 282 days; Wahl gives a figure 2 to 3 days longer. This shortening would correspond with the decrease in weight, as the average increase of weight at the end of pregnancy amounts to about 40 g. per day. The author was not able to find any substantial reduction in height and weight of toddlers despite the bad living conditions. On the whole the measurements for height and weight are mostly above Kemmerling's 1940 figures, only the weight of boys and girls 5 to 6 years old being slightly below his value. *Franz Heimann*

Statistical Aspects of Mental Deficiency due to Birth Traumas. MALZBERG, B. (1950). *Amer. J. ment. Defic.*, **54**, 427.

These statistics relate to a group of 643 mental defectives attending New York State schools in April, 1948, in whom the cause of mental deficiency was thought to be trauma at birth. The author points out that admission to state schools does not provide adequate evidence of relative prevalence.

The average age on admission was 13·4 years, half the group being admitted when less than 10 years old, and 12·4 per cent. when under 5 years of age. Statistical tables show that three-quarters were either idiots or imbeciles, and 21·3 per cent. were classified as morons or of borderline intelligence. The preponderance of males over females is considerable in the lower age-groups. The figures show that 63 per cent. of those graded as

idiots, 41·4 per cent. of imbeciles, and 31·4 per cent. of morons were less than 10 years old on admission, owing probably to greater pressure for admission of patients of low mental grade.

Three racial groups made up half of the total: Hebrews 103 (25·8 per cent.), Italians 61 (15·3 per cent.), and Irish 43 (10·8 per cent.). No data are available for the proportions of races in the general population. The Jewish population of New York State is estimated as approximately 2,000,000 out of a total population of approximately 15,000,000, that is, 13 to 15 per cent. compared with 25·8 per cent. of the defective group. A similar excess of Jews is also found among mongols in the state schools. Negroes, in spite of the fact that there has been an influx into New York State since 1940, when they constituted 4 per cent. of the population, constituted only 4·8 per cent., and the proportion of Negro mongols is also low. However, the proportion of Negro first admissions to state schools for mental defectives is in excess of the rate for the general white population.

A table is given showing order of birth and size of family in the group of 643 patients under study. There was a large preponderance of firstborn or secondborn, there being 285 firstborn and 113 secondborn. Comparison with the proportions of firstborn and secondborn in the general population shows that birth trauma resulting in mental deficiency is especially likely to occur in firstborn. Conversely, an increase in incidence of mongolism is shown as the birth order advances. *C. S. Nicholson*

Observations on the Prognosis of Children Born following Trauma at Birth. SCHACHTER, M. (1950). *Amer. J. ment. Defic.*, **54,** 456.

Out of over 3,600 children studied during the past few years, 353 were selected for investigations of neurological and mental development after "traumatic" delivery, this term including instrumental delivery or asphyxia at birth; there were 100 controls in which birth was normal. Ages ranged between 3 and 18 years, and the proportion of males to females was 244 to 109. Patients were graded into 187 socially competent, and 166 socially incompetent (not capable of rehabilitation). In the first class birth trauma did not account entirely for social incompetence, for a positive correlation between socio-economic conditions and mental level was observed. Of the 353 children, 11·04 per cent. were premature, born at the seventh or eighth month.

Dentition was normal in 61 per cent. and late in 26 per cent. Walking was late in 20 per cent., and speech retarded in 59 per cent. Out of 151 children above 3 years of age, 51 per cent. were enuretic and 2·3 per cent. were incontinent.

A family history of alcoholism was present in 32 per cent. of cases, and in 28 cases the grandparents were also alcoholic. Children from these families showed severe neuropsychiatric symptoms, notably convulsions, speech defects, Little's disease, behaviour syndromes, and somnambulism. Parental tuberculosis was found in 10 per cent. and syphilis and malaria in 16 per cent. of cases. In 21 cases out of 143 there was a history of mental disease in parents or relatives; this figure is doubtfully significant.

A table is given of neurological manifestations, the most significant of which were epilepsy, speech defects, and sleep disorders. The importance of birth trauma in relation to epilepsy is discussed. In 74 patients there was a history of convulsions and in eight true epilepsy developed. In these 74, mentality ranged from normal in one to idiocy in seven; there were 24 imbeciles and nineteen low-grade morons. Figures for encephalopathy and hemiplegia were low, and the incidence of Little's disease was also low. Tics were only encountered four times, microcephaly and idiocy only twice, hydrocephalus once, and myopathy once only. Speech defect was noted in 24 children, seventeen of whom were mentally normal; the role of prematurity in causing speech disturbance is stressed. Behaviour disturbances were found in 35 per cent. of cases and included emotional instability, delinquency, and stubbornness. Of these children, 67 per cent. were mentally normal or borderline, and 32 per cent. mentally defective, but the author points out that 36 per cent. were near puberty; he concludes that, although birth trauma may be responsible to some extent, other factors play a part.

A table of comparison between controls and children with abnormal deliveries bears out the findings in this investigation; another demonstrates that children with birth asphyxia show later dentition, later language development, and later control of sphincters than those born by forceps delivery. Parental alcoholism occurs more frequently among asphyxial children, suggesting a sensitization to anoxia. In general the author suggests that asphyxia at birth may be more damaging than forceps delivery, though data are not as yet conclusive.

C. S. Nicholson

Congenital Malformations with Severe Damage to the Central Nervous System due to Early Fetal Virus Infection. LANDE, L. (1950). *J. Pediat.*, **36,** 625.

Sixteen patients with congenital malformations resembling the post-rubella syndrome were investigated. In five patients the congenital malformations were attributable to severe common colds within the first 3 months of gestation. There was a history of maternal rubella in seven and of influenza in one. [Very strong statistical evidence would have to be produced to convince one that the common cold causes congenital deformities in the foetus. Such evidence is not given in this article.] *R. S. Illingworth*

Clinical and Pathological Considerations Based on 1,008 Cases and 100 Necropsies on Premature Infants. (Consideraciones clinicas y anátomopatológicas basadas en 1008 casos y 100 autopsias de prematuros.) SOTO PRADERA, E., and FUSTE, F. (1950). *Arch. méd. San Lorenzo*, **1,** 16.

The symptoms and clinical findings in a series of 1,008 cases of prematurity are analysed and the cases classified accordingly. Four main syndromes are described: respiratory, digestive, cardiovascular, and central nervous system. Babies with respiratory and intracranial disorders tend to die in the first 48 hours of extra uterine life, while malnutrition and sepsis are not fatal for several days. In a series of 100 necropsies on premature infants lesions of the liver were found in 12 per cent. [These cases are said to form a distinct group, but the only description of the pathology is confined to the statement

that the appearances resembled those of atrophic cirrhosis.] Vascular lesions of the placenta are said to have been found which resemble those present in acute rheumatism or periarteritis nodosa, etc. These are described as showing only the mesenchymal reactions of hypersensitivity. These findings lead the authors to suggest that some types of abortion and foetal immaturity are due to a foetal sensitization against certain maternal toxins. *George Hickie*

Maternal Nutrition and Hydrocephalus in Newborn Rats. HOGAN, A. G., O'DELL, B. L., and WHITLEY, J. R. (1950). *Proc. Soc. exp. Biol., N.Y.*, **74**, 293.

In previous experiments on rats consuming a synthetic diet a certain number of the young developed hydrocephalus; when folic acid was added to the diet the incidence of hydrocephalus was sharply reduced. This observation suggested a nutritional cause of the abnormality.

In the present series female rats were given a synthetic diet in which the protein was supplied by soy bean oil meal together with a vitamin mixture including all recognized vitamins with the exception of ascorbic acid, nicotinic acid, folic acid, and vitamin B_{12}. The incidence of hydrocephalus in the offspring was less than 1 per cent. In order to reduce the amount of folic acid available, a folic acid antagonist (methylfolic acid) was added to the same diet; the incidence of hydrocephalus then rose to over 20 per cent. The type of diet used during the pre-experimental period determined the time that elapsed before hydrocephalus appeared in the offspring during the experimental period and had also a considerable influence on the incidence of hydrocephalus.

The authors confirmed the observations of Gillman and others (*S. Afr. J. med. Sci.*, 1948, **13**, 47) that injection of trypan blue into female rats causes hydrocephalus in about 7·3 per cent. of the offspring. They think that the initial damage leading to hydrocephalus may be the same whether trypan blue or methylfolic acid is administered to the female rats.

[This is another important paper showing that the frequency of a congenital malformation may be enhanced by a specific deficiency in the diet during pregnancy.] *Z. A. Leitner*

A Study of Neonatal Deaths. A Six-Year Review. HAWKINS, R. J., and MERKEL, R. L. (1950). *Amer. J. Obstet. Gynec.*, **59**, 609.

The authors studied 243 (16·6 per 1,000 births) infants born alive (between 1942 and 1947) and dying within one month at St. Annes Hospital (Loyola University, U.S.A.). In 237 of the cases necropsy was performed. Twin births (8·65 per cent.) are [unfortunately] not excluded.

All patients were under the care of private physicians, mainly general practitioners, consultant services being available when called for. The stillbirth rate over the same period was 17·6 per 1,000 live births. A patient who had had a previous delivery before the 28th week of pregnancy was considered a primigravida. Of all the mothers concerned, 42·5 per cent. were primigravidae and they produced most of the babies dying neonatally, although the actual number is not stated.

Deaths were analysed under many headings. Of the series 7·4 per cent. were delivered before the 28th week, 27·9 per cent. from the 29th to the 38th week, 34·2 per cent. from the 39th to the 42nd week, and 0·5 per cent. after the 42nd week; 68·4 per cent. weighed under 2,500 g. In 52·9 per cent. of cases, prematurity was considered to be the main cause of death and the greatest improvement in neonatal death rate is to be expected in the group of infants premature by weight and by period of gestation.

The deaths were analysed according to the method of delivery; breech delivery accounted for 18 per cent. of deaths, mainly in the premature group. Labour was premature in 64·8 per cent. of cases of neonatal death, and toxaemia occurred in 12·6 per cent. Those latter cases tended to be admitted to hospital late; earlier admission to hospital might have saved a few babies. Placenta praevia was responsible for 6·3 per cent. of foetal deaths but conservative techniques of management had not been instituted.

Prolonged labour was a cause of death in only 9·45 per cent. of cases. Of infant deaths after 28 weeks of gestation, 50 per cent. occurred in the first 24 hours of life.

The post-mortem findings showed that prematurity alone, or in conjunction with asphyxia, was the main cause of death in 52·9 per cent. of cases. Intracranial haemorrhage was responsible for 12·5 per cent. of deaths, mainly in babies at term undergoing operative delivery. Congenital defects were responsible for 19·7 per cent. of deaths and erythroblastosis for only 2·4 per cent.

[This is an extensive investigation designed to indicate the neonatal death rates in various conditions, and an attempt to stress the most easily remediable features. It is unfortunate, however, that twin deliveries are not excluded and that no attempt is made to discuss the neonatal death rates according to the parity and age of the mother. The study is interesting in that it suggests a high incidence of premature labour for no very definite cause, though, of course, relevant statistics are not given. It is imperative to study "total foetal wastage" in an evaluation of clinical techniques as there is an interplay between stillbirth and neonatal death depending on antenatal care and treatment and degree of obstetrical operative skill.] *James Walker*

Ovulation in Lactating Women. UDESKY, I. C. (1950). *Amer. J. Obstet. Gynec.*, **59**, 843.

By carrying out successive endometrial biopsies the author has studied the question of ovulation during the lactational period; 200 such biopsies were performed in 85 women who were amenorrhoeic throughout the period of lactation, 98·5 per cent. of which showed characteristics of an "oestrogenic" endometrium varying in structure and depth, and the majority being characteristic of a mid-follicular phase of the cycle. A striking feature was that successive biopsies failed to show any progression or growth in the endometrium, revealing a static phase only. The endometrium in 1·5 per cent. had the characteristics of luteinization. In each of these cases the onset of the first period was associated. Another group comprised 121 women who had their first post-partum period while still actively lactating. Biopsy was performed in sixteen of these cases 1 to 10 days before bleeding, and in twenty cases 20 to 40 days after its onset.

In only five cases (14 per cent.) was there evidence of ovulation.

The author concludes that during lactation the ovarian cycle is almost completely suppressed and that when ovulation occurs it is followed by menstruation. His material leads him to the conclusion that the suppression is lifted gradually.

[This paper and the subsequent discussion of it by such authorities as Bartelmey, Brewer, and Davis make most interesting reading.] *Kenneth Bowes*

Maternal Obesity. SHELDON, J. H. (1949). *Lancet*, **2**, 869.

Some women become extremely obese after childbirth, but the details of the process and its causes have received little or no attention by clinicians. The author studied forty patients in whom obesity had developed in relation to the bearing of one or more of their 109 children. The gain, compared with the weight at marriage, varied from 20 to 125 per cent. Two or more phases could be distinguished: (1) an initial phase characterized by a rapid gain in weight which began abruptly and either ended abruptly or gradually slowed as the weight approached its final stationary level; (2) a phase of equilibrium in which the weight remained, perhaps indefinitely, at its new high level; (3) an occasional phase of decline in which some or all of the superfluous weight was lost. Occasionally the initial rapid phase was replaced by a slow, steady gain continued for some years. The rapid gain in weight might begin during pregnancy or immediately after the confinement and it might be a response to one particular pregnancy or to all the pregnancies; sometimes it did not appear till a late one. There was some evidence to suggest that it was more apt to arise in connexion with the birth of boys than of girls. One woman, for example, whose weight at marriage was 8 st. 7 lb. (53·5 kg.) gave birth to five girls in the next 6 years and began her sixth pregnancy with a weight of 9 st. (56·7 kg.). After the birth of this child, a boy, she gained 44 lb. (19·8 kg.) in the first 4 months and then slowly gained a further 42 lb. (18·9 kg.) over the next 3 years to reach a final weight of 15 st. 2 lb. (96·2 kg.).

In seventeen cases the obesity began with the first baby and further gains occurred with each additional child; in the others it began in the second pregnancy. As a rule the weight, once it had reached its peak, remained stationary at its high level, but in four cases it declined, in two cases without any discoverable cause, in one after pregnancy, and in one after an emotional upset. In one case, in which the weight had been stationary for 10 years, the woman lost all the weight she had previously gained. Menstruation was not affected; in one case lactation was excessive. Disturbances of carbohydrate metabolism occurred in some of the women in later life; two became diabetic and six others had abnormal glucose tolerance curves of diabetic type. That there was a hereditary element was suggested by the finding that the mothers of the women had suffered from obesity nearly twice as often as the mothers of a control group, though the sisters did not seem to be affected. There was a tendency for babies to be large, particularly among those women who became obese in each pregnancy.

The author suggests that the obesity is due to a hypothalamic disturbance which produces an obesity of similar nature to that which follows experimental injury to the hypothalamus; in a proportion of cases there is also a disturbance of anterior pituitary function which results in large babies and maternal diabetes.

F. J. Browne

A Twenty-year Statistical Review of 454 Consecutive Cesarean Sections. GEIGER, C. J., and DURBURG, J. R. (1950). *Amer. J. Obstet. Gynec.*, **59**, 588.

A comparative study was made of the operations for Caesarean section performed at St. Joseph Hospital, Chicago, in the two 10-year periods 1928-37 and 1938-47. Altogether there were 16,170 deliveries in the 20 years, including 454 by Caesarean section (2·8 per cent.). The number of Caesarean sections in the first 10-year period was 188 out of a total of 5,306 deliveries (3·54 per cent.); the number in the second period was 266 out of 10,864 deliveries (2·44 per cent.). In the first period the percentage of lower-segment sections was 32 and in the second seven. The Porro operation was performed twelve times in the second series and once in the first. Caesarean hysterectomy was carried out thirteen times in the 20 years without maternal death, the indications for this procedure being multiple fibroids and other gross pathological conditions, uncontrollable bleeding at operation, and, occasionally, severe intra-uterine infection.

The indications for Caesarean section and figures are tabulated. Cephalopelvic disproportion and previous Caesarean section each accounted for about a third of the operations, the figures varying little in the two decades. In 14·7 per cent. of the total cases, the patient was a primigravida with severe toxaemia not responding to conservative treatment; infant and maternal mortality were reduced in such cases when normal section was carried out. Caesarean section was indicated for placenta praevia in about 9 per cent. of the cases, the lower-segment operation being the routine for these. Accidental haemorrhage was the indication in about 5 per cent. of the cases.

A fall in the incidence of maternal morbidity in the lower-segment operation from 44 per cent. in the first period to 31 per cent. in the second was attributed to the use of antibiotics, sulphonamides, and blood transfusion. There were fifteen deaths (3·3 per cent.), eleven (5·7 per cent.) in the first decade and four (1·5 per cent.) in the second. The causes of death in the first decade were peritonitis (six cases), haemorrhage (two cases), toxaemia (two cases), heart disease (one case); and in the second decade, pulmonary embolism, toxaemia, haemorrhage, and aplastic anaemia respectively. Chemotherapy, blood transfusion, and the more frequent use of the Porro operation probably prevented death from sepsis in the second decade. The over-all maternal mortality in the 16,170 deliveries for the 20-year period was 0·26 per cent., 0·45 per cent. in the first 10 years and 0·17 per cent. in the second. The average foetal mortality (stillbirths and neonatal deaths) in the cases of Caesarean section for the 20 years was 9 per cent.; 10·6 per cent. in the first 10 years and 7·8 per cent. in the second. The foetal mortality for the 16,170 deliveries was 3·28 per cent.

William Love

The Frequency of Abortion. (Częstość poronień.) CZYŻEWICZ, A. (1950). *Polsk. Tyg. lek.*, **5**, 451.

Although it is well known that artificial termination of pregnancy is so common as to present an important problem in social medicine, the exact number of cases is

difficult to estimate since many criminal abortions remain secret.

The author tries to draw some conclusions from the statistics of labours and miscarriages at the University Clinic in Warsaw during the period from 1921 to 1943. In his first table he assembles histories of 52,171 women with 100,532 labours and 47,655 miscarriages. In his opinion the figures reflect the whole reproductive life of women, and disclose the frequency of abortion. The author points out that the percentage of miscarriages increased gradually from 17 per cent. in 1921 to 43 per cent. in 1943. With this goes an increase in morbidity—ectopic pregnancy, sterility, labour complications, nervous disorders. In his second table he gives the statistics for labours in Poland from 1922 till 1938. There were 16,115,000 labours, and he calculates the number of miscarriages from data in the first table. According to this the annual number of miscarriages increased from 256,213 in 1922 to 497,947 in 1938. The author considers that the decrease in the annual number of labours which has been seen especially since 1931 is due to the increased number of miscarriages and not to a decrease in pregnancies. Taking into account that the percentage of artificially procured abortions, according to some authors, may amount to 90 per cent., and that among the latter many are of a criminal nature without sufficient medical grounds, the great loss to the nation is readily seen. The author is alarmed at these facts and makes a strong plea for general action against abortion. [The problem raised by the author is of great importance; the disastrous consequences of criminal abortion alarm medical authorities in all countries. It would seem, however, that the author's figures for one district are not sufficient as a basis for calculations applied to the whole country.] *C. Uhma*

Unintentional Abortion in 1,497 Planned Pregnancies. TIETZE, C., GUTTMACHER, A. F., and RUBIN, S. (1950). *J. Amer. Med. Ass.*, **142,** 1348.

The authors studied the outcome of planned pregnancies in 1,497 women seen in private practice, of which 1,364 resulted in a living child or twins which survived the neonatal period. The authors assume that because these pregnancies had been planned by the cessation of contraception all abortions occurring must have been accidental. (Cases in which the foetus weighed under 1 kg. were counted as cases of abortion.)

There was a correlation between the age of the woman, a history of unintentional abortion previously, the time required for conception, and the likelihood of an abortion in the present pregnancy. There was a greater danger of abortion in older patients, or if there was a previous history of unintentional abortion, or if there was a long interval between cessation of contraception and conception. For example, of women over 35 years with one or more previous unintentional abortions who required more than 6 months for conception, 38·4 per cent. miscarried, of those under 25 years without a history of previous abortion who conceived in the first 3 months after discontinuance of contraception only 3·9 per cent. aborted.

The authors suggest that defects of germ plasm may delay conception besides causing abortion.

Elaine M. Sunderland

A Study and Discussion of 240 Hysterectomies. ('Corsig en bespreking van 240 hysterektonie.) STRASHEIM, E. A. (1950). *S. Afr. med. J.*, **24,** 225.

Recently there has been criticism of unnecessary operations and, in the gynaecological field, especially of hysterectomy. Therefore this survey was carried out in the Gynaecological Department of the Johannesburg General Hospital. The study covers the years from January 1, 1942, to December 31, 1948, and includes only European hospital-class patients.

All the hysterectomies were performed by two operators, or under their supervision. There were 131 total hysterectomies, 93 subtotal hysterectomies, and sixteen vaginal hysterectomies. The majority of patients were between 40 and 49 years; one patient was under 30 and in this case the diagnosis of malignant adenoma had been made. There were four deaths in the whole series of 240 hysterectomies. The first patient, aged 41, died on the table just after the uterus had been removed; at post mortem a large pulmonary embolism was seen. The uterus showed endometrial adenocarcinoma. The second death was in a woman of 59 years with a malignant cervical polyp and myomata; death occurred on the 11th post-operative day from a coronary thrombosis. The third death was due to acute dilation of the stomach after subtotal hysterectomy in a woman of 37 with multiple myomata. The last death occurred on the 4th post-operative day from pulmonary embolism after total hysterectomy in a woman of 70 with endometrial adenocarcinoma. In this case the death might have been avoided by the use of radium and deep *x* rays.

Total hysterectomy was performed in increasing proportions in the later half of the period. The author states the advantages and pleads for the more frequent use of total hysterectomy instead of the subtotal operation. The arguments usually put forward against total hysterectomy are: higher mortality and morbidity, prolapse of the vagina, greater risk of ureteric and bladder damage, and shortening of the vagina with dyspareunia. The author discusses the correct technique to avoid these complications and remarks that the cause of dyspareunia is often an unhealthy cervical stump rather than vaginal shortening.

Those cases most suitable for vaginal hysterectomy are in older women with associated prolapse in whom no contraindications, such as adnexal infections and adhesions or uterine tumours larger than the pelvis, exist.

The findings in the uteri removed are tabulated; they range from myomata and endometriosis to Krukenberg tumour of ovaries. In discussing the indications for hysterectomy the author states that, in some cases, an apparently normal uterus may be removed when it is associated with disease of the other pelvic organs or with serious symptoms such as severe menorrhagia.

Lilian Raftery

Studies on Functional Amenorrhoea under War Conditions. (Untersuchungen über die funktionelle Amenorrhöe unter Kriegsverhältnissen.) WALLAU, F. (1948). *Arch. Gynäk.*, **176,** 320.

Functional amenorrhoea is defined as amenorrhoea occurring during the normal period of maturity in a woman who has previously menstruated regularly (for at

least one year) and in whom no physical cause for the cessation of menstruation can be recognized.

Out of 212 cases of amenorrhoea at the gynecological clinic, Giessen, during the years 1939-43, a physical cause was found in 36, nine were incompletely investigated, and the remaining 167 cases were considered to be cases of functional amenorrhoea; this paper deals exhaustively with observations on these latter cases.

The incidence in the 5-year period 1934-38 was 0·8 per cent., and in 1939-43 it was 2·8 per cent.—the highest incidence occurred in 1942 and 1943 when it was 3 per cent. and 5·2 per cent. The author considers that this is a simple increase in numbers and not an increase as a result of war.

Of the patients, 82·4 per cent. were under and 17·6 per cent. over the age of 30. The preponderance of cases in younger age-groups is believed to be associated with the labile state of the genital system at this period—increased frequency of one-phase cycles. The probability of an inefficiency of the genital system is shown more clearly in the low fertility rate (30 per cent.) of the married women in this group.

The part played by such factors as occupation, state of nutrition, change of climate, nervous influences, is discussed and the conclusion drawn that these exogenous factors may play some part especially in a woman who has a labile cycle. The factor found in 141 (80 per cent.) was an insufficiency of the genital system.

In 64 per cent. there was hypoplasia of the genitals, acutely anteflexed or retroverted uterus, or a uterus less than 3 inches in length. The occurrence of hypoplasia in such a high percentage of cases of secondary amenorrhoea raised the question whether the hypoplasia was brought about by the amenorrhoea or whether it had always been present. This could not be answered. The relation of time of menarche and functional amenorrhoea to type of body build was investigated in a large series of cases. Menarche occurred earlier in thin than with fat women, and the tendency to functional amenorrhoea was greater in fat ones. The build of patients in the present series is not discussed, but 37 per cent. had an early and 10 per cent. a late menarche.

Histological investigation of the endometrium on 1,500 occasions gave the following results—atrophic in 40·9 per cent., resting in 23·3 per cent., proliferative in 21·6 per cent., and secretory in 9·1 per cent. When the duration of the amenorrhoea was longer than one year atrophic endometrium was present in 87·5 per cent. of the cases.

Observations were made on three other factors in these cases: (*a*) blood pressure—hypotension was present in two cases, hypertension in 28; (*b*) sedimentation rate—this was above normal in 27 per cent. of cases; (*c*) white-cell count—this was above normal also in 27 per cent. of cases.

Treatment was along the usual lines and based on the findings on histological examination. The best results were obtained where functioning endometrium was present; there were 87·5 per cent. of successes in cases with secretory endometrium, 55·3 per cent. with proliferative, 46·3 per cent. with resting, and 18·1 per cent. with atrophic.

Finally a few observations were made on 194 Russian women, brought to Germany during the war. Of these, 86 had functional amenorrhoea and half were under the age of 20. As in the German women, there was little relation to occupation or change of climate. In 88 per cent. the amenorrhoea lasted for less than one year; in 49 (57 per cent.) of these cases, regular menstruation started without any treatment, in ten irregular menstruation started, in nine only two or three periods occurred, twelve became pregnant, and in six amenorrhoea persisted. The author suggests that these results in the Russian women occurred because their genital system was more stable than that of the more civilized German women. *Gladys Dodds*

A Family with Eight Generations of Hereditary Cataract. [In English.] MARNER, E. (1949). *Acta ophthal., Kbh.*, **27**, 537.

The hereditary cataracts of the Olsen family in Denmark have been reviewed from time to time since 1878 when Giersing recorded twenty instances among 25 members of the group. The present author brings the information up to date, the study covering a total of 238 individuals in a period of about a century and involving eight generations. Altogether there are 132 known cases of cataract.

The condition is dominant, 50 per cent. of those with cataract having affected offspring. The type of cataract found is variable and indiscriminate, and the opacities become progressively greater. Study of successive generations reveals some degree of anticipation in the age of onset, and the age at operation has become proportionately less in general. The post-operative results as regards vision show no appreciable difference from those in other forms of cataract: discission with subsequent curette evacuation seemed to give the best results (76 per cent. attaining 6/18 vision or more). As in other forms of hereditary cataract, the visual result was often better in one eye than in the other. Three members of the family have been voluntarily sterilized, and five instances of preventive abortion are recorded. *P. Jameson Evans*

Attempted Suicide by Poisoning. (Selvmordsforsok med gift.) JOHNSEN, G., and VOGT, E. (1950). *Nord. Med.*, **43**, 1013.

This is an analysis of all cases of attempted suicide by poisoning admitted to the Oslo Municipal Hospital between 1924 and 1939. There were 278 patients in all (28 having been admitted on two occasions), 124 men and 154 women. Of these, 14 per cent. died (about 18 per cent. of the men and 10 per cent. of the women). Age, occupation, and social status, causative factors, and the poisons used are analysed. Of all attempts, 70 per cent. were made with barbiturates (mortality 10 per cent.), 15 per cent. with alkaloids (mortality 25 per cent.), and 13 per cent. with inorganic poisons (mortality about 4·5 per cent.). *W. G. Harding*

An Early Attempt at Medical Reform in England, 1844-1845. ERICKSON, A. B. (1950). *J. Hist. Med.*, **5**, 144.

Among the early efforts to promote health legislation in Britain was the unsuccessful attempt in 1844 by the Home Secretary, Sir James Graham, to introduce a Medical Reform Bill, an episode which has been strangely neglected by medical historians. There was at that time

great need for medical reform. Hygiene and sanitation had been totally neglected by the State, arrangements for sewage disposal hardly existed, the water was impure and the supply inadequate, and houses were dark, overcrowded, and insanitary. Many diseases were rampant under such conditions. There was no general control of medical practice, despite the efforts of the Royal Colleges and other bodies to secure a satisfactory standard, and quackery was widespread. Graham pointed out that each medical school had its own requirements and that some were even selling degrees. He advocated a " uniform and centralized system " governing education and licence to practise in medicine and surgery, and his scheme was to include a register of all who were fit to practise. Macaulay assured Graham of the support of the University of Edinburgh and of the Colleges of Physicians and Surgeons, but Wakley denounced the Bill and stated that the general practitioners, who were outside the control of the aforementioned corporations, would strongly oppose it. Both predictions proved to be correct. The practitioners called the new measure a " Quack Protection Bill ", as it repealed the Apothecaries Act of 1815 and opened practice to unqualified persons. In the *Lancet* it was stated that the physicians would rank highest, next would come the surgeons, and in the lowest grade there would appear the general practitioners as the " degraded caste ". Some objected to the tyranny of control, others pointed out that no regulation had been applied to midwifery. The main opposition, however, was directed against the proposed Council of Health. Under such control, said the *Lancet*, " the independence of the profession is gone for ever, the Home Secretary becoming virtually a dictator, with the doctors in his power ". In almost every English town there appeared a Medical Protective Society, with the defeat of the Bill as its object.

Nevertheless the Medical Reform Bill was not without its supporters. The *Edinburgh Medical and Surgical Journal* approved the Bill " to remove and rectify the abuses and evils " of medical practice. Admittedly it could not put an end to quackery, but the sick would always continue to employ any means they wished, and not always the regular practitioner. All that could be done was to prohibit the sale of patent medicines.

It was argued by the promoters of the Bill that the Government, in assuming control, had no desire to harm the profession, and that the idea of practitioners governing themselves was " completely Utopian ". As the result of lengthy discussion, Graham resolved to alter his Bill, and he presented it in a modified form in 1845. The Universities of Oxford and Cambridge were to be exempted, the Apothecaries Company was empowered to prosecute unregistered practitioners, and it was to be a penal offence for anyone falsely to assume the title of physician, surgeon, apothecary, or doctor.

Even in its new form the Bill offended the bulk of the profession. It was said that registration would create an undesirable aristocracy among medical practitioners and that the independence of the profession would be destroyed. Furthermore, the scheme would not abolish quackery. Richard Quain, however, strongly defended the registration system and the *Edinburgh Review* was loud in its praises of the Bill. But the opposing parties were never reconciled, and Graham, disgusted and discouraged at finding his efforts to be so futile, gave up the struggle and withdrew the Bill. The time was not ripe for so drastic a reform. Nevertheless the discussions had stimulated an interest in public health which bore fruit in the Public Health Act of 1848, and Graham's Bill was the model used by those who, in framing the Medical Act of 1858, provided for a medical council, and for a system of registration similar to that which Graham had envisaged. Thus, the Medical Reform Bill, unsuccessful though it was, formed an important link in the chain of progress which culminated in the charter for Social Security in 1948. *Douglas Guthrie*

Researches on the Measurement of Human Performance. MACKWORTH, N. H. (1950). *Spec. Rep. Ser. med. Res. Coun., Lond.*, **268**, 1.

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